Proceedings of the Seventh Workshop on a Common Test and Training Range Architecture

sponsored by the
Deputy Director, Test, Systems Engineering, and Evaluation,
Ranges and Resources

San Diego, California

18-20 November 1997

January, 1998

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Section 1

Introduction

1.1 Background

The decline in the Defense budget and Congressional concerns about duplication of range capabilities has significantly affected future range improvement and modernization funding. New technologies such as advanced distributed simulation and the need for closer working relationships between the test and training communities will require a greater degree of interoperability between test and training range instrumentation systems. Standard interfaces and asset sharing between the Services and the Test and Training Communities will lower the cost of testing and training to the Major Range and Test Facility Base (MRTFB), and allow the efficient integration of new instrumentation and simulations at minimum cost.

A series of workshops sponsored by the Deputy Director, Test, Systems Engineering, and Evaluation (DTSE&E), Ranges and Resources (RR) have been conducted to apply the expertise of the training, test, and installed systems test facility (ISTF) communities to: 1) identify the issues that must be addressed to successfully achieve range interoperability; 2) develop recommendations to resolve these issues, and (3) review and assess the direction and progress of selected initiatives already underway. Figure 1 summarizes the schedule, composition, and products of the workshops to date.

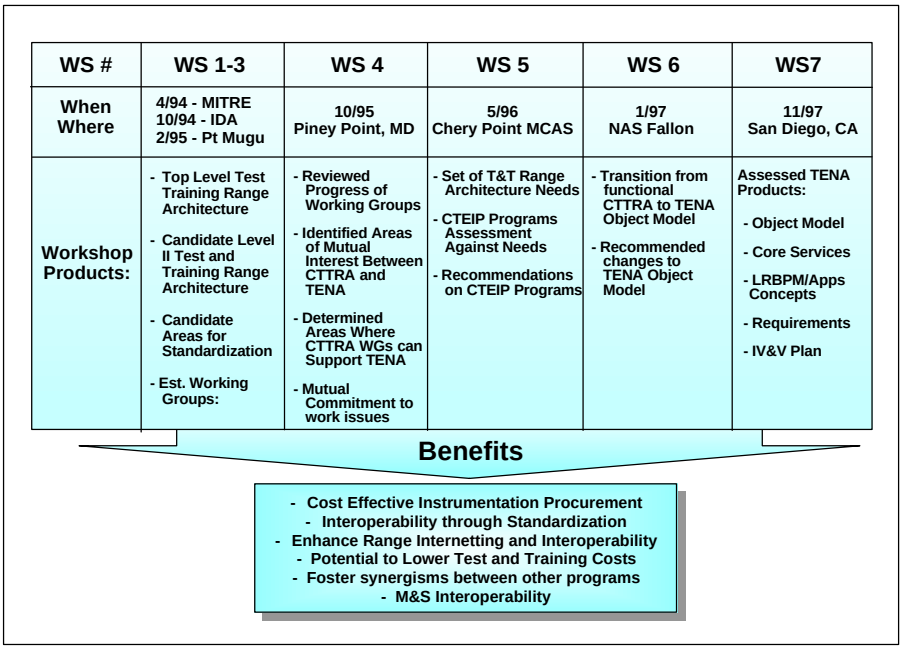

Figure 1. Workshop Products

The first three workshops produced two levels of a common functional test and training range architecture, the definition of terms for both levels, and a set of recommendations on the areas of the architecture that offered the greatest potential to provide near term (within 6 years) interface standardization payoffs.

The fourth workshop identified areas where CTTRA participants could support the Central Test and Evaluation Program (CTEIP) Test and Training Range Enabling Architecture (TENA) project. The fifth workshop resulted in a set of test and training range interoperability needs based on the above functional architecture and an assessment of four range interoperability related CTEIP projects including TENA, the Common Data Acquisition and Processing System (CDAPS), Virtual Test and Training Range (VTTR), and the Regional (formerly Joint) Test and Training Range Complex (RTTC) against the needs. The sixth workshop produced a mapping of the functional architecture developed in the first three workshops to the TENA Object Model (OM) architecture, and a set of recommendations on the TENA OM to include additions, deletions, and modifications to objects and their attributes.

1.2 Seventh Workshop Objective and Process

The seventh workshop was held 18-20 November 1997 in San Diego, California. The list of attendees is at Appendix A and the agenda at Appendix B. The objective of the workshop was to assess selected elements of the TENA Baseline Architecture Report which was delivered in October, 1997. The selected elements included:

1. The TENA Baseline OM (Volume IV, Section 2) which provides a conceptual view of the components (classes) of the TENA architecture.
2. The TENA Core (Volume IV, Section 3), which consists of the invariant system infrastructure services and mandatory system applications required for TENA
3. The core set of requirements (Volume III) which drive the TENA architecture.
4. The Logical Range Business Process Model (LRBPM) (Volume V) and TENA Applications Concept (Volume VI)which define how to conduct a test or training exercise in the Logical Range environment.

Excerpts from the TENA Baseline Report were e-mailed to the Workshop invitees and registrants. The complete 10 Volume report was make available on the World Wide Web (WWW) at http://www.acq.osd.mil/te/programs/cttra/ and http://tecnet1.jcte.jcs.mil:8501/Presentations/Baseline/.

Four assessment groups were established to assess each of these elements. Assignments to the groups were based on the preference of each registrant. Each group was supported by a facilitator the MITRE Corporation and one or more Subject Matter Experts (SME) from the TENA project office. A fifth group was established midway through the workshop to evaluate Volume VII, Integrated Verification and Validation (IV&V) Plan. This last group was comprised of the Core Services Assessment Group which completed its original task sooner than anticipated.

In addition to presentations by the TENA SMEs (Appendix C) during the assessment phase, the workshop included presentations from RR on the status of the CTEIP Foundation Initiative and the Joint Test and Training Range Roadmap (JTTRR) (Appendices D and E

respectively). All briefings are published separately from the proceedings and are available at http://www.acq.osd.mil/te/programs/cttra/.

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Section 2

Workshop Results

2.1 TENA Object Model Assessment Group

The group elected Jeff Schwalb, from Naval Air Warfare Center/Weapons Division - China Lake, CA, as the spokesmen and leader of the TENA Baseline OM group. Mr. James Balestrieri, of The Chapin Group, a TENA contractor, was assigned as the group's TENA SME. The representatives listed in Table 1 participated in the assessment group's deliberations.

Table 1. Object Model Assessment Group Membership

Last Name	First Name	Organization
Balestrieri	James	The Chapin Group
Del Valle	Luis	AFWTF
Furlong	Clark	AFDTC
Hack	Wyn	Computer Sciences Corp.
Heiling	Randall	412TW/TSD
Hines	Terry	The MITRE Corporation
Johnston	Steve	NSWC PHD Dam Neck
Lydon	Tom	Veda, Inc.
Rosenthal	Harold	NAWC/WD
Schawlb	Jeff	NAWC/WD
Sitzman	Rick	ACC/388 RANS/DoD
Chalfant	Tim	Edwards, AFB, CA
Tuttle	Jim	NAWC/AD

The first item was a briefing, provided by the TENA SME, on the object modeling notation (Rumbaugh, et. al.) used by the TENA project. The material covered: objects, class, instance, attributes, operations and multiplicity provided a consistent framework for further discussions by the group on the TENA Baseline OM.

Copies of section 3.0, TENA OM, contained in Volume IV, Technical Reference Architecture (TRA), were distributed. Figures 9, the Baseline Level-Zero OM, Figure 10 the Mission Space Class, Figure 11, the Logical Range Resource Class, and Figure 12, the Logical Range Resource Class (Expanded), were discussed in great detail. After careful review, the group decided there was no way to determine where to end the class structures. There was concern the OM could get so long that it would be unusable. The SME stated that a OM browser tool, called the Logical Range Support Tool, was originally scheduled to be developed but that it was unclear when it would be available. The second item, which would become a frequent theme throughout both working sessions, was that it was impossible to fully access the OM until a few scenarios were evaluated. The SME referred to these as "Use

Cases" and "Event Traces" and in the future tools used to develop and evaluate scenarios would be provided by the TENA program.

The group continued to review the OM and concluded that its relationship with the TENA Core Architecture and the Core Services was unclear and that a concerted effort to clarify the association is required. The group also concluded that it was inappropriate to include Communications and Computers (Instrumentation) under the Subclass "Logistics" and that another Subclass should be created for these categories of range assets.

The group also concluded that the OM does not accurately reflect a system that arrives at the test facility with on-board or embedded test sensors and equipment. While no specific recommendations were provided, the TENA Program was asked to address this concern.

The Wednesday morning session began with a review of the four questions submitted by the TENA Program Manager and the question submitted by MITRE. The questions are as follows:

1. Does the structure of the OM make sense? If not, what specific changes would you suggest?
2. Does the flow from the CUSTOMER to the TEST/EXERCISE to the LOGICAL RANGE, MISSION SPACE and RESOURCES seem logical? If not, what specific changes would you suggest?
3. Does the flow from MISSION SPACE, PRIMARY RESOURCES, SECONDARY RESOURCES, to LOGISTICAL RESOURCES seem logical? If not, what specific changes would you suggest?
4. Does the structure appear flexible enough to meet your needs? If not, what specific changes do you suggest?
5. Is the OM extensible to the other logical range resources, Measurement Facilities (MF), Hardware in the Loop (HITLs), etc.

The entire morning session focused on Question 1. During the discussions the SME was asked if anyone with high level programming language had been involved in the OM development. The question reflected a discussion of software code reuse. The SME responded that the OM would be used, as shown, to initiate a software build in FY 99. Follow-on discussion indicated that the group did not find the OM suitable to initiate software development. However, one member of the group, with software development experience, did state that the current OM was a typical starting point in Object Oriented software development. The SME stated that he felt the OM was adequate to start software development but that with the program now moving to an element of the Foundation Initiative, he was uncertain how CDAPS would use the OM.

The discussions then moved to the topic of scenarios and use cases. The SME described the tank testing scenario that was included in Volume X, entitled "Other Supporting Information". Although Volume X did show five different tank testing scenarios, it did not show what the group described as Internal/External object interactions. In addition the group found that the static OM needs to be enhanced with a dynamic OM.

The group then began reviewing the final issues that would be addressed the morning update briefings. Figures 2 through 4 are the three slides briefed by Jeff Schwalb.

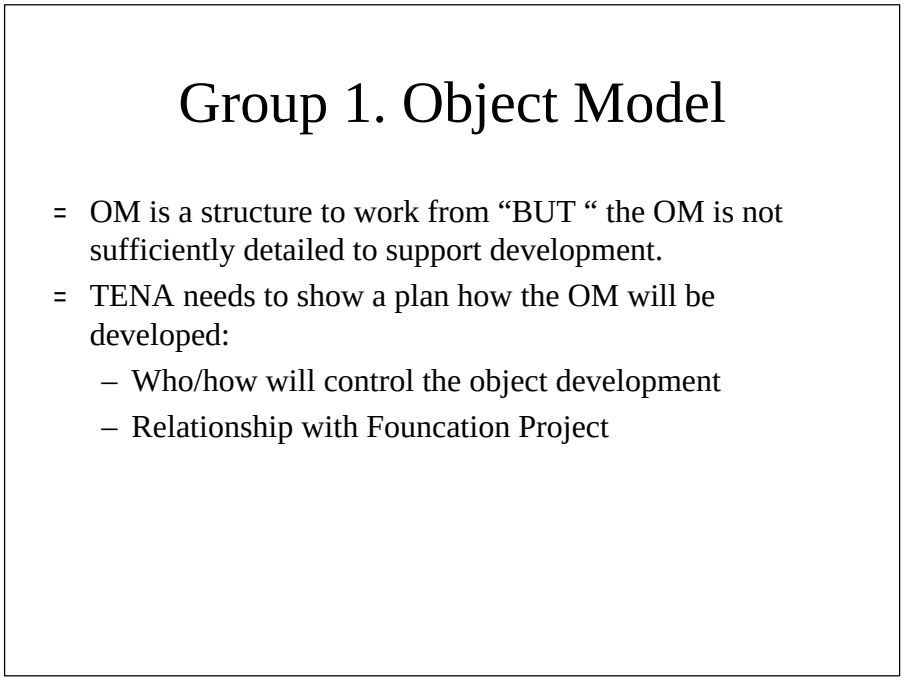

Figure 2. Initial Outbrief - Slide #1

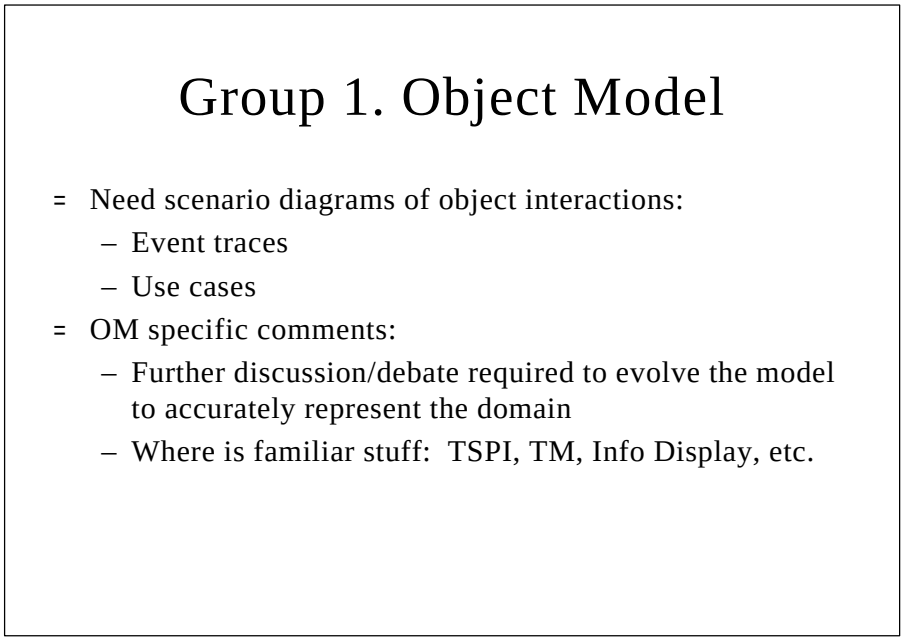

Figure 3. Initial Outbrief - Slide #2

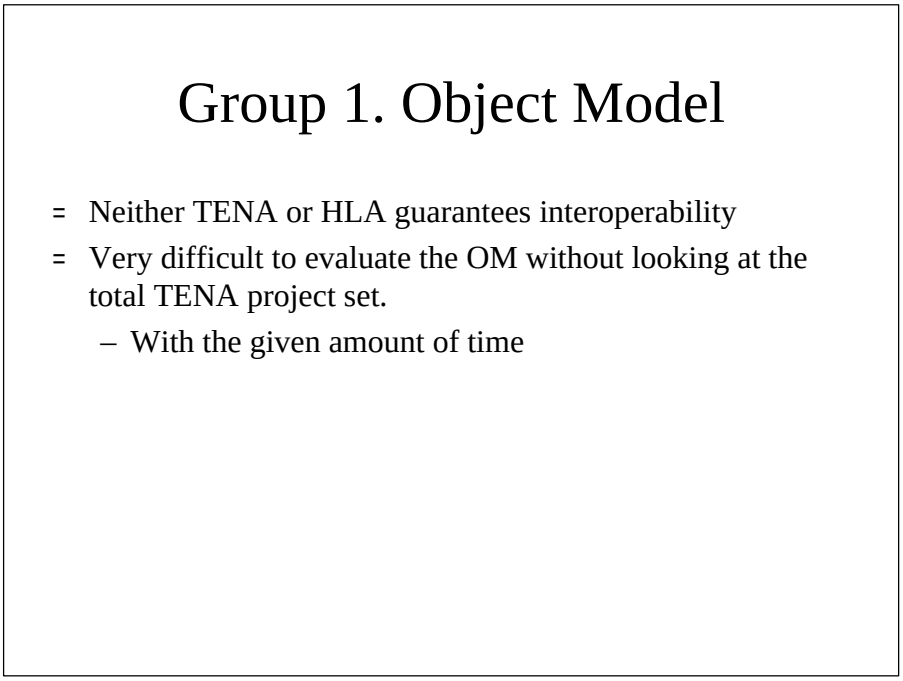

Figure 4. Initial Outbrief - Slide #3

The Wednesday afternoon session began by addressing the other four questions, shown previously. The first issue addressed was actually question 5, does the OM need to be expanded to include the other facilities, Measurement Facilities, Hardware-in-the-Loop Facilities, and Installed Systems Test Facilities? The general thought is that the OM is the same for all T&E facilities but that it will require further work to show that the OM is adequate. The specific concern is, as an example, in ISTFs you control the environment and at an Open Air Range you measure the environment. There is no discussion in the OM material on this type of concept. The group recommended to the SME that a major benefit to the community would be a common data format that could be used by all types of test facilities.

The group then looked at the Sensor Class and began to realize that the OM may be too detailed for certain applications. They agreed, however, that it should be studied and assessed further.

The group then went back to the issue of an aircraft arriving on the range with its own on-board test sensors and how this would be reflected on the OM. Specifically the group was concerned that the customer would not be able to see how the on-board Global Positioning System (GPS) downlink would be processed.

The group was concerned that there was no traceability of the changes made to the OM that occurred from CTTRA VI to CTTRA VII. The SME stated that the OM changes reflected the addition of the business model. The SME indicated that a TENA goal was to provide a process that when a customer arrives at the range, all of the assets will be automatically planned and scheduled and that an estimated bill could be generated. Several

members of the group would like to see TENA stop work on the business process and concentrate strictly on the technical aspects. One member of the group felt that the business model should actually be part of the JRRC Foundation Project. The SME stated that the Software Engineering Institute had advised the TENA Program that any project that failed to address the business process was doomed to failure. The group endorsed the development of a procedure that provides a history of changes.

The group addressed the Environment Class of objects shown in the Mission Space Class. There was concern that while it was possible to measure the Natural environment in an open air range or affect the Natural environment in simulation, it was not clear how the Tactical, Political and Doctrinal objects were going to be instantiated. In addition, the group was concerned that Person under the Participant Class should be a derived object and not an attribute of the Participant Class.

The Baseline Level Zero OM shows a shaded area referred to as Tools which include OPEN, PAN, ZOOM. The group recommended removal of the Tool and moving these methods or processes to the Information Display Object in the next version of the OM.

The remainder of the afternoon session and the beginning of the Thursday morning session was used to prepare the final group briefing slides which are shown in Figures 5 through 11 below.

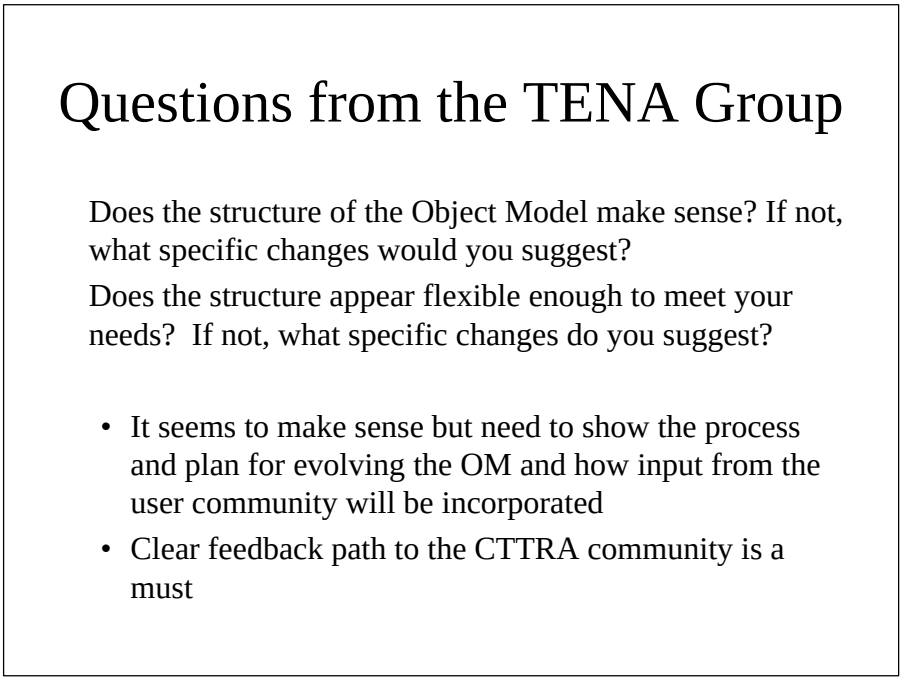

Figure 5. OM Assessment Group - Outbrief Slide #1

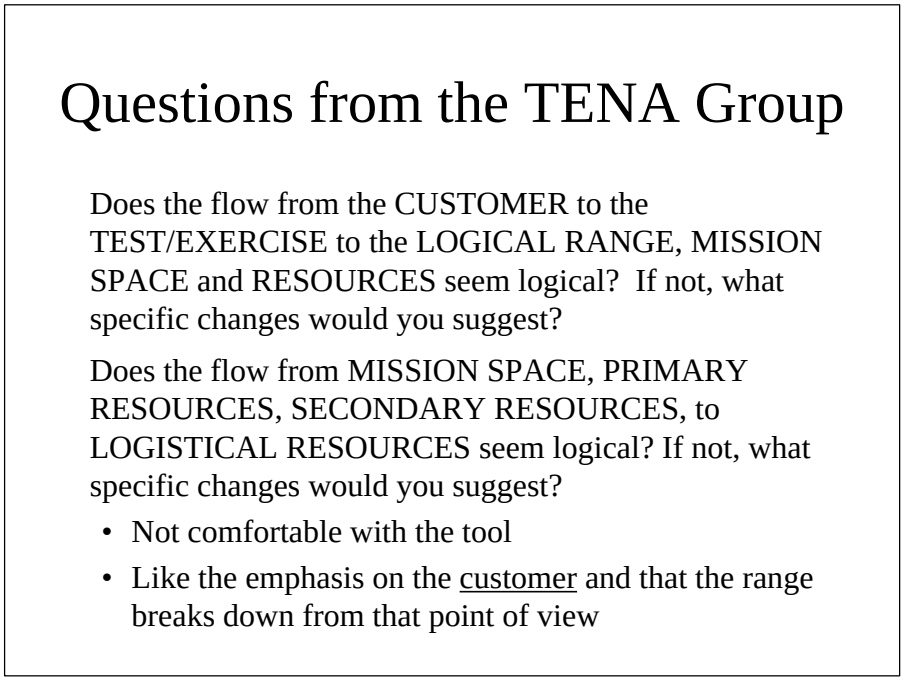

Figure 6. OM Assessment Group - Outbrief Slide #2

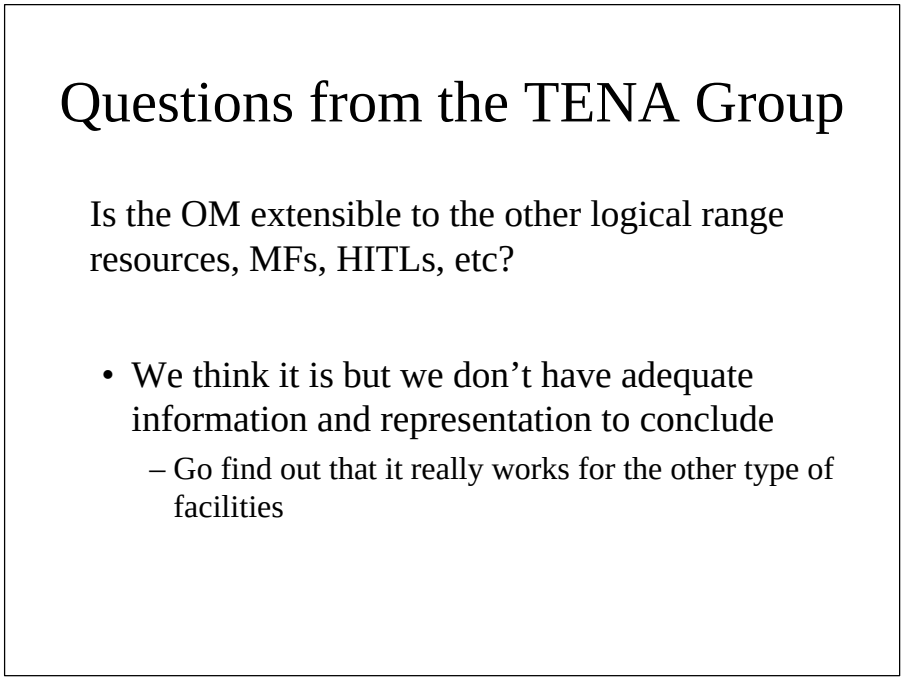

Figure 7. OM Assessment Group - Outbrief Slide #3

Strengths of the OM

It exists

- much work has been done to build the model
- it has been captured (written down) for us to analyze

Although we spent a significant amount of time tearing it apart it did not collapse

Figure 8. OM Assessment Group - Outbrief Slide #4

Weaknesses of the OM

We only have a static view of a framework

- need a dynamic view of the model as well

We did not see some of the object things we were looking for

- Where is information display?
- What is the relationship to the TENA core?
- Some confusion about how sensors on platforms are represented.
  - How would the model process TSPI and TM?

Figure 9. OM Assessment Group - Outbrief Slide #5

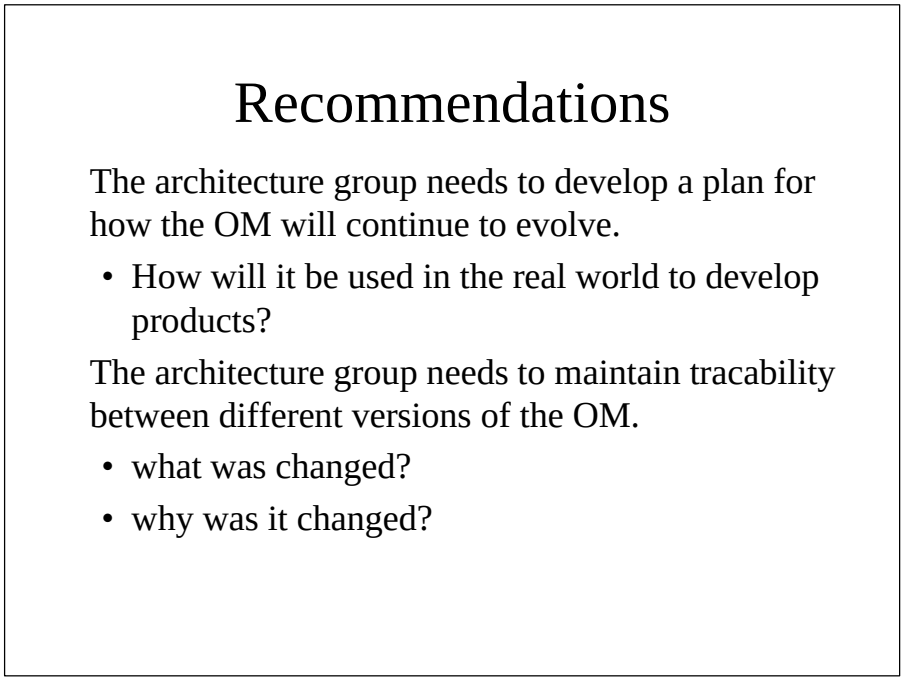

Figure 10. OM Assessment Group - Outbrief Slide #6

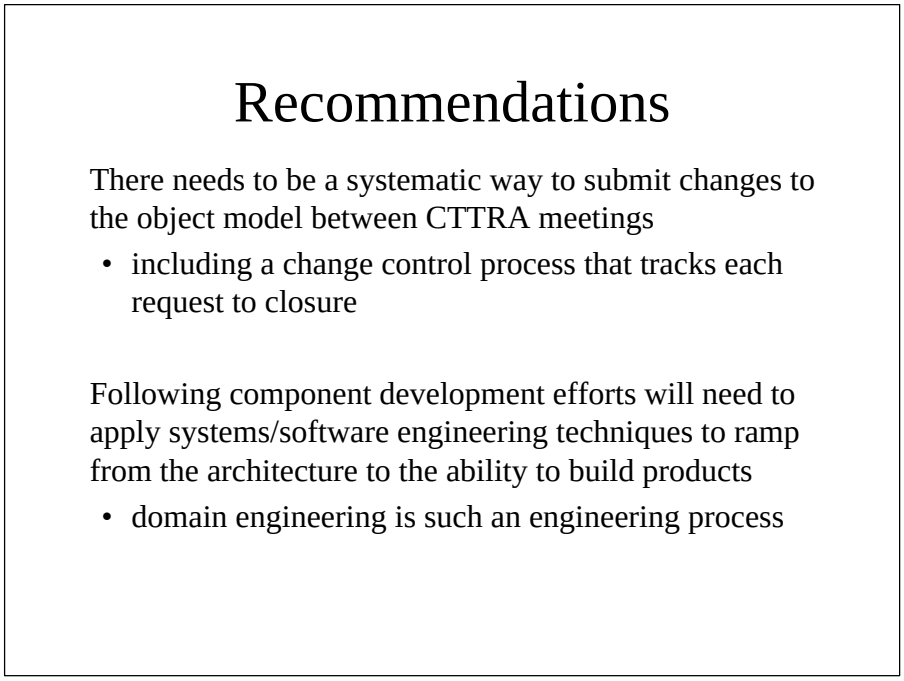

Figure 11. OM Assessment Group - Outbrief Slide #7

2.2 TENA Core Services Assessment Group

2.2.1 Introduction

The Core Services assessment group met on the afternoon of the first day to assess the Core Services portion of the TENA Technical Reference Architecture, Chapter IV. The participants are listed in Table 2. Part-time participants included Rick Long, Tom Lydon, Joe McMorrow, and George Rumford. Mike Borowski served as the facilitator and Joe Batman represented TENA as the SME to the group.

Table 2. TENA Core Services Assessment Group

Last Name	First Name	Organization
Batman	Joe	Software Engineering Institute
Blase	Fred	SAIC
Borowski	Mike	MITRE
Bozack	Tomas	NAWC/WD
Chavez	Tom	WSMR
Crump	Pete	TYBRIN Corp
Damron	Mark	PMRF
Diez	Jeff	30th Space Wing
Gardner	Ray	RTTC, AMTEC Corp
Gibson	Jon	WSMR
Haddock	Victor	AFWTF
Hayes	Rick	DMSTTIAC
Jensen	Bob	Nauticom
Larson	Cliff	ACC USAF
Moore	Andrew	Aberdeen Test Center
Payne	Mike	NAWC-AD
Salas	Steve	AFFTC
Santos	Jerry	NUWC
Vick	Austin	Dyncorp

An initial sampling of the participants revealed that the majority had read the Core material, but there was clear consensus that few clearly understood what was meant and how it fit together. Bob Jensen and Joe McMorrow addressed the issues and it was revealed that the read-ahead material was excerpted from the baseline report. As a stand-alone document, the TENA Core Chapter did not contain the additional detail desired to facilitate understanding and the group would have preferred the full ten volume set for detail and reference. Expertise in the room was used to fill the gaps.

2.2.2 General comments

Considering the state of development of TENA, the group agreed that the document provided a good top-level view of the TENA Core Services. However, the document does

not go into enough detail to thoroughly evaluate the architecture. The group would like to see explicit details of range interfaces with TENA core to answer implementation questions. Throughout the course of discussion, it proved difficult to separate core issues from core implementation issues.

The fundamental understanding that the TENA Core was the 'glue' that integrates the system, was easily acknowledged. The terminology "Management Services" and "mandatory applications" proved confusing, as many did not realize that both services and applications were mandatory TENA infrastructure. "Mandatory" as applied to core components led to the question of whether a mandatory service means that the existing component in a system is to be TENA compliant or whether it is mandatory that each system use the OSD funded core components in order to be TENA compliant. There was, in fact, little debate on the need or value of the basic core services and applications, but as these were introduced the subject of implementation rose to the forefront.

A central issue was determining the *absolute minimum* level of services required to be TENA compliant, later coined "TENA Lite." One area of concern was the cultural acceptance of a massive influx of new systems crowding a control room and totally changing the way a range operates. Whether this was a black box mounted on top of every console or all new consoles, there was clear concern about TENA overpowering the range structure as it exists today. Another concern was whether TENA compliance required the exclusive use of TENA code, or if TENA services produced by local range applications would suffice. It was determined that the applications at each site would be tailored to that site, but the services required to establish TENA compliance and connectivity are mandatory. Mandatory applications will be developed by TENA and distributed to all. The goal is to ensure the quality of service required at each node of the virtual range is provided. Additionally, the question of who would fund the development and installation of the infrastructure was raised. Finally, questions on which ranges will receive TENA services in which order were raised. These all comprise implementation, which was not the direct focus of the group or the SME. Some of the questions were referred to George Rumford, and others to Joe McMorrow.

The group determined through discussion with Bob Jennings that Distribution Services and Message Services were the absolute minimum core services for TENA Lite. Implementation issues will become the purview of the Foundation Initiative. The funding of individual range compliance will become the responsibility of the ranges. It is hoped that as the TENA evolves, its enhanced capability will entice ranges to *want* to achieve compliance and enhance their own capability. The order of compliance will naturally occur as testing and training programs require testing and training range services from those facilities.

The majority of the implementation issues were not addressed during the group session, but were referred to the Transition Chapter for reference and to SMEs beyond that. It was acknowledged that many of the specifics for transition have not yet been determined. It was posed to the group that they should choose (recommend) which objects should be transitioned in which order. Each range should pick what can easily be sliced off to begin TENA compliance. Implementation as a whole is under development and will benefit from input by the ranges.

Of the core services, only clock services was questioned and discussed in detail. One concern was that, since the High Level Architecture (HLA) uses a simulated clock, TENA may require the same. In some instances, a real clock is preferable on the range. Does TENA (and HLA) exclude the use of an external clock? The answer was "no", but this could not be ascertained from the Volume IV document. The recommendation from the group was to address the timing issue, especially in light of the differences between the HLA Runtime Infrastructure (RTI) and the ranges' Real-time Interface. This was only the first reference to the TENA-HLA relationship.

The relationship between TENA and the HLA was addressed in the latter section of Section 4, Volume IV. The group clearly was not familiar with the HLA and raised numerous questions on what it does and how it will impact TENA. The linkage between TENA and the HLA is hard to view and bin. There proved a need to clearly define the differences and agreements. With the SME feeding the group on the HLA questions, it was agreed that TENA should be a superset of the HLA. As opposed to bridging to the HLA for simulation interoperability, it was recommended that TENA go beyond bridging to adopting HLA as a whole. As a part of this, it was recommended that as TENA develops additional requirements for the HLA and the HLA RTI, and that TENA present these service calls to the Defense Modeling and Simulation Office (DMSO) Architecture Management Group (AMG) for addition to the HLA. The document would benefit from an enhanced discussion of the relationship and the group was interested in seeing the next steps in building the linkage between the two.

The group was clearly interested in the next steps in the TENA development process. Many indicated their ranges were approaching the point of system upgrade and were seeking TENA guidance. Questions on the Foundation Initiative, roles, and how to implement TENA remained. These were passed on to George Rumford as a precursor to his Foundation Initiative briefing.

2.2.3 Specific Issues and Recommendations

Item: Core Services
Issue: What are the minimum core services that can comprise the TENA core?
Recommendation: State the absolute minimum TENA core services.
Discussion: Absolute minimum core services are Distribution Services and Message Services. Discussion in the group indicated a desire to add additional services incrementally. Other aspects of TENA may require the additional services. The Group would like to see how required core services will be provided and who will provide what.

Item: Description of TENA core
Issue: Use of terminology "mandatory applications"
Recommendation: Separate the word mandatory for clarity. State something to the effect of 'the use of required applications is mandatory'. Reason: Clarity.
Discussion: More than one individual did not ascertain from the read-ahead material that the use of the 4 TENA services *is mandatory*.

Item: TENA vs HLA
Issue: Relationship between the two.
Recommendation: Map relationship between TENA and HLA. Include differences in terminology, compliance requirements, and timing interfaces to facilitate understanding. Continue development of the next steps on this issue. The group's final recommendation was to adopt the HLA as a whole for TENA use.
Discussion: HLA RTI and range RTI are not the same thing. How will TENA RTI be implemented? Beginning with this issue, discussion included questions concerning how to bring simulations into TENA and how T&E would relate to TENA. Discussion continued with HLA as a subset of TENA. Discussion included what is the definition of a bridge and what does it do? All agreed this is an area for continued development. In the course of adopting the HLA, TENA should propose more RTIs to the DMSO AMG for addition.

Item: Terminology
Issue: There are multiple sets of terminology
Recommendation: Standardize terminology
Discussion: TENA must align with the work DMSO has done with RTI and terminology to facilitate understanding and minimize confusion especially as related to TENA and HLA (and Modeling and Simulation) terminology. (Note: If the HLA is adopted as a whole by TENA, the TENA/HLA terminology inconsistencies will disappear as HLA terminology is adopted. The vocabulary proved confusing in numerous instances. "Mandatory applications", "logistics", and the use of the word "secondary" when classifying range services as secondary vice primary resources. The inference of "secondary" carries connotations of 'lesser importance' and might inadvertently lead to loss of funding in today's austere fiscal environment.

Item: TENA compliance
Issue: Can we differentiate levels of TENA compliance?
Discussion: Is TENA compliance a 1 or 0 or is it a question of implementation level? What is the minimum? Related, how many services are required (to reach critical mass) for compliance? Introduction of the concept of TENA Lite. There is a document titled "Adaptation Guidelines" that was not available for use.

Item: Core services at range sites
Issue: Core services developed by range sites equivalent to TENA
Recommendation: Clearly state that core services must be identical at all TENA sites. This is invariant.
Discussion: If ranges had developed their own programs for achieving TENA core capability, would this suffice? Words imply you cannot run TENA without the core software applications. Is this strictly true? Or could you write your own application? (To close the loop:) Is it only the TENA invariant code that is acceptable?

Item: Clock timing
Issue: Circumstances exist when an external clock may be necessary. Does TENA account for this?

Recommendation: As the timing issue is refined (too detailed for CTTRA VII WS), have SME's address the impact. One solution is to have clocks run at sub-rate and super-rate of real time.
Discussion: There are times when an external clock might be needed. Since TENA is a superset of HLA, does that imply that an external clock cannot be used? How does TENA clock services encompass real time clock services? Additionally post mission processing may require sub- and super- clocks.

Item: Distribution services
Issues: none
(Note: The group was specifically asked if they had questions, issues, or comments on Distribution Services. They acknowledged the need for the services but had no additional comments.)

Item: Message services
Issues: none
(Note: The group was specifically asked if they had questions, issues, or comments on Message Services. They acknowledged the need for the services but had no additional comments.)

Item: Connection services
Issues: none
(Note: The group was specifically asked if they had questions, issues, or comments on Connection Services. They acknowledged the need for the services but had no additional comments.)

Item: Infrastructure support objects
Issues: none
(Note: The group was specifically asked if they had questions, issues, or comments on Infrastructure support objects. They acknowledged the need for but had no additional comments.)

Item: Guidance on building core services
Issue: When can community expect to see guidance on how to build core services?
Recommendation: As soon as possible.
Discussion: Two members of the group reported they are currently overhauling their facilities' systems/catalogs, and building for future capability. TENA guidance will ensure minimal re-work.

Item: Security
Issue: When will it be incorporated?
Recommendation: Security requirements need to be defined early to ensure architecture can support and minimize rework. Recommend adding to the TENA documents now.

Discussion: Security will be a show stopper if not done properly. This has not been addressed yet. HLA security will be done differently. Multi-Level Security (MLS) for TENA has a long way to go. Security people should be involved early.

Item: Catalogs.
Issue: No specified layouts (yet).
Recommendation: Define and publish soonest.
Discussion: Many references are made in document. Is it premature to develop these layouts? Master asset catalog and Information Class Catalog (ICC) mentioned specifically in document. Two programs represented within the group are working on their own asset management systems and would like to develop them in accordance with what TENA envisions.

2.3 Integrated Verification and Validation Plan Assessment Group

2.3.1 Introduction

The IV&V Assessment Group, formed from the TENA Core Services Assessment group, assessed Volume VII, Integrated Verification and Validation Plan as an additional tasking after completion of the TENA Core Services assessment. Participants are listed in Table 3. Part-time participants included Rick Long, Tom Lydon, Steve Johnston, Jim Hooper, and Sholom Cohen. Since this group was ad hoc, none of its members had read Volume VII. Accordingly, the approach taken by SMEs Jim Hooper and Shalom Cohen was to walk through the volume with the group.

Table 3. TENA IV&V Assessment Group

Last Name	First Name	
Batman	Joe	Software Engineering Institute
Blase	Fred	SAIC
Borowski	Mike	MITRE
Bozack	Tomas	NAWC/WD
Chavez	Tom	WSMR
Crump	Pete	TYBRIN Corp
Damron	Mark	PMRF
Diez	Jeff	30th Space Wing
Gardner	Ray	RTTC, AMTEC Corp
Gibson	Jon	WSMR
Haddock	Victor	AFWTF
Hayes	Rick	DMSTTIAC
Larson	Cliff	ACC USAF
Moore	Andrew	Aberdeen Test Center
Payne	Mike	NAWC-AD
Salas	Steve	AFFTC
Santos	Jerry	NUWC
Vick	Austin	Dyncorp

Complementing the Volume VII material are 8 scenarios used integrally with the 4 phase IV&V process. They were not included as part of the review due to time constraints, but were frequently referenced by the SMEs.

The single greatest obstacle throughout the IV&V discussion was the confusion resulting from the use of the term "IV&V". The IV&V label carries connotations from multiple communities and TENA's redefinition of the acronym resulted in the application of software and M&S IV&V expectations to a process that was neither. Throughout the course of the afternoon, it became apparent that there was confusion as to what was being verified and validated, the TENA architecture, its components or the system installed as the logical range. The group unanimously recommended abandoning the IV&V term for the process described by TENA Volume VII.

The stated goals of the TENA Integrated Verification and Validation are to:

1. Analyze the TENA architecture for specific attributes
2. Verify the effectiveness of the architecture elements
3. Validate the ability of the architecture to support operational systems

TENA ***Integrated*** *Verification and Validation* is NOT the same as Independent Verification and Validation as applied to either software development or Modeling and Simulation. What is provided in the Volume VII material is a "standard DoD IV&V process tailored for TENA". By TENA definition, it is a process that integrates the Product Line Approach, Logical Range Business Process Model and Architecture.

2.3.2 Four Phased Process Review

The four-phase process was reviewed according to the figure on page 10 of the document. As each phase was explained, questions arose concerning TENA IV&V in contrast to other definitions of IV&V.

Phase I verification of the Technical Architecture against the requirements was characterized as a paperwork exercise. In Phase I, the objective is to lock onto architecture requirements. The Software Architecture Assessment Method (SAAM) is employed. The process is driven against a series of development scenarios. (8 samples previously mentioned are for Technical architecture development.) TENA stakeholders develop these scenarios to exercise the architecture against the proposed operational scenario to assess usability. The principal question is "Can the architecture meet the requirement of the scenario?" Under SAAM, different approaches are possible. Discussion included how/who would select each scenario. Additionally, how do you know it is the right scenario to represent x percent of the real world? The answer is that the objective is only to say that the architecture is heading in the right direction. Each range will set its desire of confidence based on testing. From these, a determination that it "looks complete" for the operational scenario would be made. There is no established level of confidence set on the part of TENA or the Foundation Initiative. The group recommended that guidance from the Foundation Initiative in this area would be beneficial. Continuing with the discussion of scenarios, the DMSO AMG employs "Use Cases" under the HLA. In the DMSO process the AMG took a use case and postulated a

structure. The AMG has developed 20-30 possible use cases. These include great detail and postulate message flow to best address the problem as you know it. There is no statement as to if it is the right problem, it is the best estimate of what will be required of the architecture. If later it is determined that something breaks the TENA, some architecture maintenance group will repair or modify the architecture. This architecture "maintenance group" will be required to be supported by TENA SMEs. From this point in Phase I it would be possible to determine specific architectural upgrades to obtain the desired capability across the architecture. This would span only one application domain (e.g. an Open Air Range (OAR), ISTF, etc.) and for each other use of the logical range, a capability determination would be required.

The next step is to build components, starting with the core. Phase II is a test of the architectural elements against specific range instances. Phase II has some infrastructure hardware and software elements in place.

Phase III includes testing the implementation against range operator expectations and test plans. This includes acceptance testing and integration testing. Two questions that arose were: "Whose acceptance testing, and what expectations will become the standard?" The definition of acceptance criteria was not included and again the classic IV&V definitions left the group asking what would be verified and validated against what and why.

Phase IV is the V&V of the installation of all elements of the logical range at the operational level. Questions arose concerning the meaning of Phase IV compared to the other phases. Additional questions included how much V&V would be required and how would a subset of the domain be chosen in order to say the IV&V was finished? Would there be a representative cross section? What is the criteria? These questions returned to the classical definition of V&V. It was suggested that traditional V&V definition should be applied beginning at Phase III and clearly in Phase IV, with the classical M&S V&V questions applied to the situation. These questions include: How much V&V is enough? When is V&V complete? What confidence is required? To put the Phase IV discussion in context, an example using the Asset Manager was presented.

The group found the example helpful as it clarified many ambiguities by illustrating a number of issues such as; (1) Do all Asset Managers plug into each other? (2) There may be several kinds of asset managers. Do they all work the same? (3) The process must ensure any variability does not change the operation of the system. Do we need to verify for each type of Asset Manager? That is one reason for commonality, or do we hope that the entire class can be validated? The explanation included how the process of verifying TENA architecture works, including some "what if" scenarios. Final determination was that it would be necessary to go down to specifics that make up each Asset Manager to validate. If the application follows the rules provided, it will work.

Referring to the "Integrated" dimension of the TENA IV&V, (integration of the OM, approach, logical range business process model -hence the term integrated), aspects of performing V&V on the "Business Process" were discussed. One issue directly stated was, "If the architecture does not support/agree with the established business processes in place at given ranges, then what?" The answer was equally direct, acknowledging the need to resolve the issue as TENA matures. Continuing discussion in this area, one comment made was that

if business processes were involved in IV&V, then it is another opportunity for TENA to fail. A clarification point was made that the term “business process” was meant to focus on operational implementation or range use, not the financial aspects of range operation. The group agreed that the architecture should follow the logical thought of how things are done and not the money trail. The Terminology "business process" is naturally associated with dollars vice the operational way of doing business. The group recommended that the term “business process” not be used in the discussion of TENA IV&V because of the implication of performing IV&V on the financial aspects of the business operation.

2.3.3 Additional Questions

The group continued to explore the confidence issue with additional questions and discussion. Questions posed by the group and the responses by the SMEs were as follows:

Q: Does the methodology test the envelope of the system? Are there methods to explore failure modes?
A: It will be up to the user to bring these issues to the range. Floor comment: We will want to avoid testing TENA in pristine environments.

Q: Is there guidance on how to establish failure modes?
A: There should be.

Q: It seems that designers should define a performance envelope? Is that the case? Are there specific components that need to be explored?
A: These should be identified up front. For example in communication, we will want to ensure we can push bits fast enough. We need to identify critical elements in the TENA. The architecture tries to control the level of complexity. If we understand small numbers/amounts of complexity, can we leverage large numbers and high complexity? This is undetermined. We want to try to understand the system enough to have confidence in the final configuration.

Q: When is enough enough?
A: Determination will be individual by user scenario. It will also depend upon the level of confidence required by stakeholders.

Q: How far does TENA have to go to satisfy stakeholders and partners?
A: The process is not clear. (Referencing phase III:) The idea is to have a complete infrastructure and use it for test or training. We envision operators using displays and connected systems functioning to satisfy stakeholders. Exactly how you get to that point is not yet clear.

Q: Analogy: If Phase III is below initial production, can we assume some testing occurs? Then is phase IV OT (Operational Testing)?
A: Phase III is a validation of selected applications integrated with TENA. The creation of the 'logical range' is demonstrated by connecting a range with another range and/or ISTF or HITL. Phase IV was envisioned to be the installation of TENA on an operational range to

evaluate the TENA architecture's capacity to conduct parallel operations in a real-time daily environment for some extended period (say 6 months). Phase IV is really the OT. Phase III is advanced DT, if we think in traditional terms. - From the DoD standpoint, there would need to be a strategic partner buy-in point. Some organizational buy in point. In the past (non-TENA programs) many failed due to lack of support, or lack of interest.

2.3.4 Additional Steps in the Process

A return question posed by the SMEs to the group was if they were satisfied with the generic process that they had seen from the Volume VII document? With discussion and the acknowledgment that there was no other detail (no other IV&V plan), the group determined that this is not an IV&V plan. The documented process is not complete. This is a starting point. TENA will need more detail and a plan. In the Volume VII document, terminology "abuse" is killing TENA. There is, however, a good framework in the effort presented to date.

The suggested next step is the development of a test plan for the Synthetic Environment Tactical Integration (SETI) initiative and determining what aspects are high risk. Using SETI, what elements of the architecture should be tested? The group expected a more defined architecture. One possibility is to take the services as defined and write code using the existing RTI to get a notion of how these services work. Although the Developmental Test Centers (DTC) are exploratory, with a better defined TENA, DTCs could be used for evaluation. Point of funding: It was questioned what would need to be produced as a result of the DTC Effort? Possibly a full test plan or full verification plan? Other suggestions included a template or a generic test plan, containing elements of architecture. These might be applied across DTCs and have the DTCs test the architecture. An additional question was whether DTCs will develop and populate objects. The answer was yes. The plan is for IV&V of architecture and then the TENA implementation.

2.3.5 Final thoughts on the TENA IV&V process:

Q: Can this be used as a Framework, and is the next step to have CTTRA or a defined body (possibly the Joint Interoperability Test Command (JITC)) act as a validation group?

A: It is a framework. There is a need for a validation framework. It will be necessary to work with DTCs to develop what you will test and then refine the IV&V. This will be close to verification of a concept model, but is a long way from IV&V of a system.

The group thought that the deliverable was an IV&V plan when components were built. What is conveyed in discussion is IV&V over the lifecycle of the system, not concentrating on just the components built. There is a need for better education on that and the suitability of the architecture development. As changes to the system are made over time, determine if it works - make TENA V&V a cradle-to-grave process. This concept has not been done by DoD. There is not a defined set of structured steps…it is NOT done at this time. TENA exists on paper. This IV&V process must be applied over the lifecycle of the program. The question is how? The group concurred that part of the Foundation Initiative is to continue to develop and validate TENA. One way is to look at what DTCs do to see if they satisfy critical aspects of TENA. This is the long term intent, a series of exercises allowing exploration of segments of architecture. Eventually TENA will fill in the requirements, a

walk before you run type of approach. TENA must employ use cases and live exercises to make it a real IV&V process and ensure success.

2.3.6 Recommendation

The group recommended that at least one more version of the TENA IV&V would be required to satisfy the needs of the ranges. It is important to separate validation of the architecture fromwith traditional IV&V. As other TENA products are developed, the document will have to address these additions. The opinion expressed was to V&V the tools independently of the architecture, then address the combined system. In fact, it will be necessary to verify/validate TENA-compliant tools within the architecture to ensure performance. Combined systems V&V will be necessary after individual tools are evaluated. At the highest level this will result in IV&V of the Foundation Project as a whole and not just the TENA. It is hoped that the Foundation will add guidance to the V&V process in terms of minimum requirements.

2.3.7 Issues Summary

Item: Terminology
Issue: TENA's use of IV&V carries unintended connotations as applied.
Recommendation: Do not apply the IV&V acronym to the TENA "*Integrated Verification and Validation".* Change from IV&V to another term. One recommendation is TENA Validation Plan. Others are possible.
Discussion: The term IV&V has specific meanings in both the Software/W world and M&S world. TENA will interface with both. The TENA terminology caused significant misunderstanding among the group members.

Item: Framework provided
Issue: Is the Chapter VII materialit a V&V framework?
Recommendation: Change the terminology to architecture validation framework or other term.
Discussion: Related to the terminology issue above, IV&V for TENA is not classical IV&V. There appears to be a need for verification and validation of architectures, but no known formal process exists. There is no other detail (no other IV&V plan). The Chapter VII document is not a comprehensiven IV&V plan. It isThis is a starting point. TENA will nNeed additionalsome detail and then develop a plan.

Item: TENA V&V definition
Issue: Multiple dimensions and layers of V&V are possible. TENA V&V requirements have not been determined.
Question: What is the Ffoundation Initiative position on V&V?
Recommendation: IV&V, in the traditional sense, will need to be conducted on the Foundation as a whole, and appropriate processes developed.
Discussion: There is Cconfusion as to what is being V&V'd? Is TENA, the architecture, components, or the entire system being evaluated? Who verifies and validates what portion? Does TENA validate or do individual facilities conductdo their own? What is the logical order for verification and validation? Should it be done for iIndividual components,?

aArchitectures,? or nNetworked applications? Significant discussion highlighteds the need for a clear process for TENA V&V (the traditional V&V definition is assumed). The 4 phases provide a framework to accomplish this. Use Ceases were given as an example for how to perform the integrated V&V. Numerous elements exist in this issue. This should be addressed to develop the process at this early stage of TENA maturity. The group nNoted that TENA V&V must be a lifecycle process, vice a one time assessment. As applications are developed and modifications are required, some standing architecture maintenance team must be available to provide support. Does the methodology test the envelope of the system? Are there methods to explore potential failure mode? It aAppears to be up to the user to bring this issue to the attention of the range. It seems imperative to aAvoid testing TENA in pristine environments. Is there guidance on how to establish failure modes? - If not, tThere should be. There is a need to Must identify critical elements in the TENA. Question: When is enough V&V enough? Is the determination set by each iIndividual user according to theirby user scenario? There appears to be mMultiple stakeholders involved. Will there be a specified level of confidence set by TENA?

Item: Terminology
Issue: Business process
Recommendation: Select alternate term to describe the process through which the ranges conduct operations and provide services.
Discussion: The term "Business process" carries financial connotations. This is aAlso linked tightly to the term "Business Process Model". For the integrated V&V framework, the idea to be captured is was how ranges conduct operations and provide services as a roadmap for V&V. No financial linkage is to be assumed. The aArchitecture should follow the logical thought of how things (events, exercises, operations) are done and (not the money $$ trail). It should follow the oOperational portion vice fiscal aspects way of doing business. The tTerminology "business process" is generally associated with dollars.

Item: Continuing development
Issue: What are the products from DTCsDTC's?
Question: Will they produce fFull test plans, full verification plans, template? Template? or possibly a Ggeneric test plan, containing elements of the architecture? Will this be applied aAcross all DTCsDTC's? DTC's test architecture?
Discussion: The group Hhoped to get some information from the Ffoundation Initiatives. ….

Item: Continued development
Issue: Next step
Recommendation: TENA nNeeds a test plan for SETI.
Discussion: What aspects are high risk? Must ensure that a methodology exists for DTCs to verify/validate critical risk areas of the architecture.

2.4 Requirements Assessment Group

2.4.1 Introduction

The Requirements Assessment Group membership is listed in Table 4. Many of these people had attended the sixth CTTRA workshop which evaluated the TENA Object Model. Several members of the group also had supported TENA in various stages of its development.

Table 4. Requirements Assessment Group Members

Last Name	First Name	Organization
Bernard	Tom	AFMC
Chalfant	Tim	Edwards AFB
Downs	Gene	RTTC, AMTEC Corp
Fahrner	Greg	Veda Corp
Garcia	John	SAIC
Gibson	Jon	WSMR
Goins	Lorenzo	TRADDOC/DCST-CTSD
Grahn	Bill	AFMC, AFFTC 412TW/TSDI
Grigson	William	DMSTTIAC
Hammond	Marvin	MITRE Corp
Hopper	Jim	Sakonnet Technology Group
Jones	Robert	96 Communications Gp, Eglin AFB
Long	Rick	TYBRIN
Lucas	Bill	ASC/WMA
MacDonald	Tom	TASC
Merhoff	Henry	NAWCWD
Metz	Tom	Dyncorp
Morgan	Joan	ATC
Olkowski	John	GTRI
Pepper	Bill	Harris
Roodbeen	Steve	NUWC (TENA SME)
Smith	Larry	46TW/TSWW (PRIMES)
VanDoren	Earl	AFOTEC
Youmans	Cory	STRICOM
Wyant	Kerry	OPTEC

Although several of the members had read the Requirements volume prior to attending the conference, the review was initiated by the TENA subject matter expert (SME), Steve Roodbeen, who expanded the overview of the document that was given earlier on the first day. Using that expansion as a basis, the reviewers asked numerous frank and pointed questions to gain a better understanding of the approach and the results. In fact, the SME didn't finish giving his overview of the approach and the results until the afternoon of the

second day. By the end of the two and a half days, the reviewers had reached general consensus on their feelings regarding the document and what the next steps should be.

2.4.2 Overview

The reviewers were generally surprised that the requirements document was not firmly based on a set of (generally) approved documents and that those requirements were not in turn used to derive the object model which describes the TENA architecture. As was learned during the presentation and discussion, the requirements were derived via a multiple iterative bottom up, top down, and hypothesis solution approach.

The bottom up aspect included visits to numerous ranges to gain knowledge of why they did things the way they do, why they procured and how they used various assets, and what they saw as their future needs. The top down approach included:

1. The recognition that the M&S community was being directed to follow the HLA approach and that community was a major portion of the TENA scope
2. That the interconnection and/or joint utilization of range assets was to be part of several future program plans, and
3. With a projected further range consolidation, there would be the need for increases in the number of and in wider scopes of joint range utilization activities.

The possible solution aspects came from the results of several programs within other functional areas (e.g., distributed computer, communication, and M&S systems) which found that the object orientated approach was the best means to structure an architecture for distributed activities.

After understanding this background, the reviewers felt that since TENA used this particular approach, that in order for the TENA architecture to be fully accepted by the T&E and Training communities, the final TENA requirements should be presented in a more conventional manner and each requirement should be traceable to widely accepted items. Those items could include one or more of the following:

1. Approved visions statements, stated needs, results of studies, and directions from senior DoD leaders. They could also be based on such items as Vision 2010 or Spacecast 2020. Another basis would be the results of the planned Foundation Program efforts to prepare something like a joint operational requirements document (JORD).
2. Stated program test and evaluation and/or training exercise needs. It was recognized that those needs are often not well expressed and generally do not include much definitive information in the out years.
3. Stated needs, visions, and/or goals that have been expressed by the various ranges. Some of those could come from the proposed efforts that were submitted to such programs as Joint Test and Evaluation (JT&E), CTEIP, Test Investment Strategy (TIS), Test Resource Master Plan (TRMP), etc.

Given that a firm set of requirements is established and each of those requirements are based on such items as mentioned above, then the selected TENA approach should be derivable from those requirements and a full justification presented as to why that approach

was the best. There is need to have these requirements directly show a capability to do testing better, faster, and/or cheaper.

Unless an explicit process is used and the resulting requirements are tied to direct benefits for the ranges and programs, the acceptance (or buy-in) of the overall TENA program may prove to be difficult. By having the requirements scrubbed and validated via ties to such things, there is less likelihood that unnecessary links or components would be purchased and the resulting varying implementations at the different sites would be not only accepted but eagerly sought.

2.4.3 Comments on Volume III, Requirements

2.4.3.1 Areas of Major Confusion

The approach used to describe the requirements was very difficult for many of the members to understand. It was only after the bottom-up, top down, and hypothesis approach was (generally) understood that the reviewers could then begin to grasp the idea that common attributes were selected and then grouped in a hierarchical manner, i.e., placed within the triangle (See Figure 12) used to describe the requirements grouping. The rationale used in the grouping activity was solely on the basis of commonality; this seemed to be very weak. In addition, the rationale for the hierarchical splitting of the requirements into Architecture Characteristics, Technical Reference Architecture, System (or Domain) Architectures, and Base (or Implementation) Requirements (figure 5 on page 21 of the Volume III) was not fully understood by many reviewers. This splitting was done by following a Domain Engineering process; a process which most reviewers did not understand. This lack of understanding was further complicated by the use of the words technical reference architecture (TRA). The use of TRA was new to the reviewers. Some confused TRA with the DISA Joint Technical Architecture. (See Joint Technical Architecture, Version 2, Second Draft dated 31 October 1997 and the definitions of the architectures within Section 1.1.5.2 of that document.)

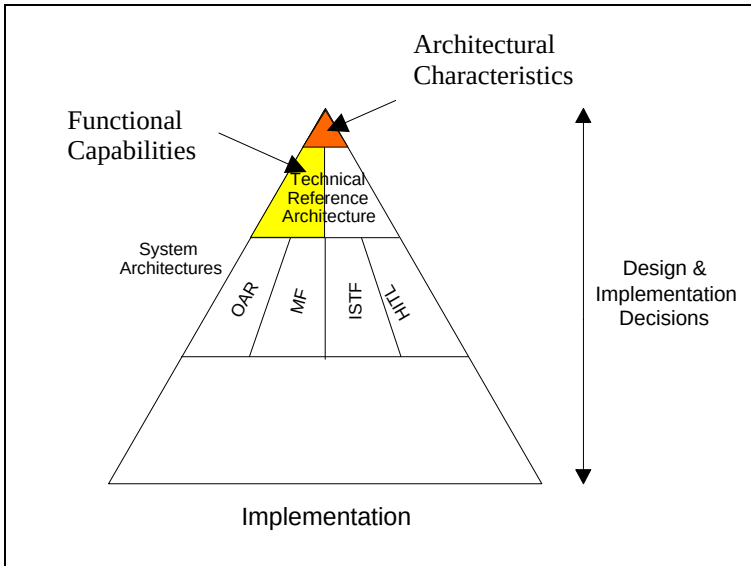

Figure 12. New Title: TENA Requirements Structure and Grouping

The triangular representation of the grouping was of some help yet the fact that the tip of the triangle contained the overarching requirements seemed to run counter to the normal use of a triangle where the tip involved the lesser important items. In addition, the use of the bottom of the triangle to represent the base requirements which were in reality the left over, i.e., non-common requirements seemed backwards to normal usage of a triangle where the base would be the foundation upon which all other things are built upon.

The reviewers had extreme difficulty in understanding the definitions of logical range, system (such as used in the phrase a TENA compliant system), and requirement. A definition of a logical range was found in Volume 6; that definition made sense but it was not repeated within Volume 3 (the requirements volume). Representative of the concern about the definition of a system was: Could a single radar be a TENA compliant system? The answer from the group was generally "No." When that radar was interconnected with other assets then the whole set of assets could perhaps form a TENA compliant system. The use of the word requirement was apparently used in a very loose manner – a manner that most reviewers could not accept. Also within the document there was confusion as to how the author defined and used technical, operational, and functional requirements.

The last area of confusion was how the TENA effort and its associated requirements related to several other major test and training R&D efforts, i.e., VTTR, CDAPS, and JRRC. It was felt that there should be strong inter-relationships (based on the proposed Foundation Program) among these and many other DoD programs. The TENA requirements need to include those relationships. (Mr. George Rumford indicated during a briefing presented on the last day of the conference that there is to be a strong inter-relationship within the Foundation Initiative.)

2.4.3.2 Suggested Restructuring Ideas

As mentioned within the Section 2.4.2, Overview, and implied within the above areas of confusion, the volume needs to include the specific bases for the requirements. In some cases this bases may be formal requirements documents, but in most cases they may need to come from summaries, interpretations, implications or logical consequences of such various documents, studies, findings, or the items that were listed in the overview Section 2.4.2.

The authors should seriously re-consider the retention of the triangle concept of expressing the requirements; unfortunately no other approach was offered by the reviewers. But the reviewers did feel that if that approach was retained, a much better explanation of the rationale of its use (including examples) should be included.

As the reviewer focused on the requirements listed within the TENA Functional Capabilities section, it was felt that the requirements contained within the first part of the Core Functional Capabilities sub-section (paragraph 1. on page 13 and including items labeled 1.1-10) seemed to be more applicable to requirements associated with a Logical Range than to TENA. [The SME did indicate that an earlier version of the document did have most of those items as being Logical Range requirements.]

The reviewers did feel that the items within the second part of the Core Functional Capabilities sub-section (items labeled 1.11-38) were appropriate for a set of TENA architecture requirements. Since the reviewers did not go through each of those items in

detail they were not able to concur with all of them; but the concept of what those items sought to include was on the right track.

2.4.3.3 Specific suggestions

For a requirements document to be worth its salt, it must contain such words as shall, will, must, etc. This document does use the word shall several times before a long list of capabilities. As the reviewers looked over those lists of capabilities, they could think of several scenarios wherein some of the listed capabilities would not be necessary. (Unfortunately those scenarios and capabilities were not fully described.) The authors should re-assess the all inclusiveness implied (demanded) by the use of the word shall as it introduces a list of capabilities. In some cases the word should would be more appropriate.

In the description of several of the specific requirements the authors used the word policy. As described by the SME and acknowledged by the reviewers, the intent of those requirements is valid, but the use of the "p" word raises more red flags. As such, it is suggested that the word policy not be included but other words be used to describe the intent of the requirement and to reduce the likelihood of alienating the range leadership.

Within the triangle structure used to describe the TENA requirements, the Architectural Characteristics portion contains what several members described as motherhood statements, the 'ilities". In the review of those "ilities" the reviewers found there were five such capabilities that needed to be added. These are fidelity, safety, traceability, security, and affordability.

There was some discussion that in the real world, when systems are being procured and/or re-configured for use in a specific system-of-systems, not all of the ilities can be met within the time, cost, and performance constraints placed on any given activity. As such, these ilities need to be prioritized or grouped in a manner that makes the resulting activity the most cost effective. The reviewers could not come to consensus as to the best way to describe this needed management decision process within a requirements format.

2.4.4 Next Steps

The reviewers recognized that the TENA program may be re-grouped into a larger Foundation Program and as such may not continue at the same level of effort nor the same scope. Even so, the reviewers felt that for completeness the requirements volume should be modified based on the above suggestions and that the authors should be given additional help in that process. As such the reviewers suggested the following next steps.

It was recognized by the reviewers that as with all programs, there are funding and time limitations, but for this requirement concept to be fully accepted and perhaps validated, it needs to be expanded in two directions – width and depth.

1. Some reasonable effort needs to be expended to address and include the major aspects of several other domains. These would include HITLs, measurement laboratories (ML), ISTFs, and/or others. Although the CTTRA VI workshop suggested that TENA go wide in its scope, the inclusion of only one domain within the requirements did not seem to follow that suggestion. Additional domains need to be included if the requirements concept is to be validated.

2. For the requirements to be of greatest value, they need to be driven down to include the requirements for a specific system such that a project leader could actually go out in the real world and procure/or develop such a specific system. The current document does start that going down process within just one domain and then to describe only one particular element, i.e., a needed radar system. But even for this one element, the process stops short of reaching the needed real world case that would validate the approach. Several of the members remembered that such a real world example was requested within the recommendations of CTTRA VI workshop, i.e., this was the second time this suggestion was made.

The exercise to go wide and deep is suggested to help ensure that both aspects of the requirements generation process has been thought through.

The reviewers also recognized that in fairness to the authors, it would be awkward for them to make changes and then have the document reviewed by another set of people from the ranges which may or may not agree with the recommendations of this particular reviewers. Thus to establish some degree of consistency, the reviewers pledged to make themselves available to re-review the modified volume. There was the expectation that such modifications could/should be made within the next two to three months. The reviewers promised that such a review would be done in a timely manner.

The reviewers also pledged to aid in seeking the buy-in among their peers and respective management organizations of the resulting requirements document given appropriate changes were made to the volume.

2.5 Logical Range Business Process Model/Applications Concept Assessment Group

2.5.1 Group Makeup and Assessment Process

The members of the LRBPM/Applications Concepts Assessment Group are listed in Table 5. Mrs. Alice Rodriquez represented the TENA Project Office as the (SME) to the group. Mr. John Nicholas from MITRE served as the group facilitator. Mr. Jack Benzie was voted the group spokesman and Ms. Lisa Sales volunteered to serve as the group recorder.

Mr. Nicholas opened the first session of the assessment group on Tuesday afternoon by presenting an initial set of questions that the TENA Project office wanted the group to answer. These questions are shown in Figures 13 and 14. Mrs. Rodriquez then presented a briefing on the IDEF process used to develop the LRBPM and began to step through the model itself an solicit comments from the group. Some discussion ensued and specific comments were recorded. However, it became evident that many in the group had not yet read Volume V or VI. Additional copies of both Volumes were distributed and the group encouraged to read them prior to the start of the Wednesday morning session.

The group reconvened Wednesday morning to continue assessing Volumes V and VI. Comments and recommendations were discussed, recorded and then reviewed by either the individual making the comment or the group at large to insure the intent was accurately captured. One group member submitted a list of written questions which were consolidated with the others. This set of issues and recommendations was reproduced and distributed to

the group at the end of the Wednesday's session with direction to prioritize the importance of the issue or recommendation as high, low or medium. Fourteen members of the group completed and returned assessment sheets. The results were compiled into one prioritized issues and recommendations list which provided the basis for the group's out brief to the plenary body on Thursday morning. This list, suggested changes to the LRBPM IDEF0 diagrams, and the out-briefing are presented in the following section.

Table 5. LRBPM/Applications Concept Assessment Group Membership

Last Name	First Name	Organization
Benzie	Jack	USMC/AVTB
Carney	DeVere	Raytheon
Cozby	Rick	TECOM
Damron	Mark	PMRF
Dyer	John	NSWC Dam Neck
Fuller	Bob	EWA
Harrison	Patricia	NUWC/AUTEC
Hurlburt	George	JPO for T&E/TECNET
Husser	Lou	Walcoff
Keck	Eric	JADS T&E
Nguyen	Chris	412TW
Nicholas	John	MITRE
Russell	Bill	NAWC-AD
Russell	Ronald	46th Test Wing/TSWG
Sales	Lisa	TRW
Switzer	Earl	Edwards AFB
Thompson	Joe	AEDC
Wallace	Ron	ACC/99Range

LRBPM Seed Questions

- **Is the relationship/utility of the LRBPM to the Technical Reference Architecture components of TENA (Object model, Core, and Standards/Protocols) clear. If so, is the LRBPM necessary to implement these components?**
- **Is/are the LRBM and the identified processes/activities:**
  - **comprehensive and inclusive/consistent with other process models?**
  - **reflective of current and future operations?**
  - **applicable to OAR, HITL, ISTF facilities? If not, what are the differences and holes?**
  - **applicable to both test and training range operations? If not what are the differences and holes?**

Figure 13. LRBPM Seed Questions

Applications Concept Seed Questions

- **Does the concept of using the exercise definition / business process as the unifying paradigm across domains make sense to you?**
- **Is the defined process flexible enough to meet your local needs?**
- **What changes would you suggest?**

Figure 14. Applications Concept Seed Questions

2.5.2 LRBPM/Applications Concept Assessment Group Products

The products of the LRBPM/Applications Concept assessment group included: 1) A prioritized list of issues and recommendations on Volumes V and VI, 2) recommendations on the LRBPM IDEF0 diagrams, and 3) an out briefing to the plenary body.

2.5.2.1 LRBPM/Applications Concept Prioritized Issues and Recommendations list

At the end of the second day each member of the group was given a copy of the list of issues and recommendations that had been developed during the 1st and 2nd days of the Workshop and asked to prioritize each item on the list as high (H), medium (M), or low priority (L). Group members were also asked to annotate their list with any comments or clarifying remarks. Fourteen (14) group members returned prioritized lists; the results, were tabulated and sorted on the H (high priority) column. The compiled and prioritized list is shown in Table 6. Note that the H, M, L tally on all issues does not equal 14 since not all members recorded a vote on each issue. Remarks were transcribed following the workshop.

The consolidated list was presented to the group the morning of the third day with the intent to clarify issues and recommendations and consolidate any the group felt were redundant. However, time did not permit completion of these tasks and the list was left as is to insure no bias would be injected by the preparer of the proceedings.

Table 6. LRBPM/Applications Concept Prioritized Issues and Recommendations

#	Issues/Recommendations	H	M	L	Remarks
28	Linkage to test investment process is a critical one in terms of resources necessary for architecture to succeed than better able to identify shortfalls. Link: 1. Test Investment Process 2. Test Planning Process 3. Test Execution Process Include T&E model in appendix	10	0	0	
44	Systematic Reuse Application Concept and Continuous Insight Application Concept need to be expanded upon. Need to articulate these concepts - currently there exist only placeholders.	10	2	1	
25	Address problems of schedule, how to appoint a lead w/o threatening management; provide them with a more comprehensive guide in language they can understand.	9	3	0	
31	Feedback loops need to be added to the unmatched requirements and needs to be redefined.	9	3	1	
39	Foundation Project should include LRBPM as a component to be tested in their exercises.	9	3	1	1) only if the “B” (Business) is retained in the acronym.
1	Use Softer Approach	7	2	2	

Table 6. LRBPM/Applications Concept Prioritized Issues and Recommendations (continued)

3	People concerned about how they can use this - take it to the next level - make it an OM - define your objects (schedule funding resources) then define your attributes, and then people will identify with your model and will feel like it is a "tool" they can use.	7	4	2	
5	Does this relate to the MRTFB business model? Show relationship.	7	3	3	
19	Vol 5 should be less threatening: 1. No reference to the word business 2. "notional" "conceptual" "tailorable" are words we should not use in materials 3. Get more of a consensus- reiterate this to ranges	7	2	3	
20	Some members concerned that pursuing the LRBPM will jeopardize implementation of the TRA and the Foundation Project.	6	1	5	
35	Add a new first block to "Define Information Requirements (6 blocks on "Define Logical Range Scenario")	6	6	2	
36	Add facility requirements.	6	4	3	
48	Unmatched requirements / define a Logical Range Scenario - needs feedback to define/develop resources not already on the shelf.	6	1	0	
2	Concept of the LR as explained in LRBPM is frightening	5	3	3	
9	LRBPM vs. TRA linkage - what causes us to mix the two? More detailed required.	5	4	3	
13	Can we use the TENA Architecture w/o the TENA business model - should we decouple business process and architecture? (planning, scheduling, financials). Is this coupling necessary, or is it detrimental to the technical architecture?	5	2	5	1) Coupling is necessary, but need to change "business" wording to "Test and & Training" to make it more palatable to TERC, Range CCs, etc.
21	Involve the Test Planners/acknowledge management fear.	5	3	3	
29	Show traceability from DoD Enterprise Model to T&E and Training to the LRBPM	5	5	2	

Table 6. LRBPM/Applications Concept Prioritized Issues and Recommendations (continued)

30	Add a "Test the Plan" block at the top-level process between the "Plan" and "Execute" blocks. Rationale: Logical ranges are relatively new and add risk to the successful execution of a test. New tools procedures are needed to support testing of the LR scenario. Lower level processes under "Test the Plan" would be compliance testing, V&V, Acceptance Testing, and Integration testing.	5	5	2	
46	"Tools" need to be addressed (defined)	5	1	5	
11	Does Financial Model need to be used? Explore which diagram built into the program	4	2	5	1) not yet
12	Unify the definition of the BPM so that all are on the same page. Do we currently hold the same definition?	4	1	7	
16	Change "Execute Plan" to "Execute Test/Training Exercise"	4	1	6	
26	Need a more comprehensive definition for "Scenario" and "Customer Requirements" for DT community.	4	4	4	
37	Need broader definition of logistics.	4	3	6	
41	In all cases when applications are being considered, consider (commercial and Government applications) current and legacy systems for applicability and use in the refinement of OM, Core Services and Applications as opposed to further refinement of the LRBM	4	5	4	
49	Need feedback from schedule to define to determine initial cost estimate.	4	1	2	
6	Change definitions to those more applicable to the entire community	3	2	8	
7	Emphasize Test AND Training in written materials.	3	4	5	
14	Is LR being confused or used interchangeably with BPM?	3	1	7	
15	Change "Plan" to "Plan Test/Training Exercise"	3	2	6	
22	Change LRBPM to LR Test and Training Process Model (LRTTPM) to get away from "business".	3	4	5	
24	Document all site visits better.	3	6	4	
27	Perception exists that model has been diluted to encompass training.	3	4	5	

Table 6. LRBPM/Applications Concept Prioritized Issues and Recommendations (continured

34	Add additional box (box #5) to the plan. "Test the Plan". Bridge between the "Plan" & "Execute Plan" (see previous bullet). Make it beginning of the "Execute" or the end of the "Plan" blocks.	3	4	4	
38	Break-out "Setup" block to a higher level	3	3	7	
43	The BPM is the OM in motion - this should be reflected in the volumes. Merge Vol 5&6A?	3	4	4	
50	Need to show funding coming in. Model shows financial documents as an output, but needs to be an input or a mechanism/control. In a fee for service situation, $ is an input. In a mission funded situation $ is a mechanism as it provides the work force and the assets, or it is a control as it limits what can be done.	3	3	2	1)Disagree - think TENA should avoid discussing financials & budget, etc. as a potentially threatening concept killer - stress the technical gains & savings
51	Over and above all this is maintaining the range infrastructure.	3	0	3	
4	Feedback from scheduling to defining, more explanation on the model required for comprehension	2	9	2	
10	Can business model be better linked?	2	4	4	
18	Is there a current logical model (how do we do business now) for comparison or for transition?	2	3	7	
32	Expand upon the fact that there are no real time (page 5) constraints to this process.	2	5	5	
40	Implement on an INTRA level first (locally) before on an INTER level.	2	6	4	
47	I liked the use to of the word "business" to highlight the fact that we are all running businesses - either operating a range, developing a weapons system, of providing force readiness. Although we are not for profit, we need to attend to almost all the other aspects of a business - in fact, the analog to making a profit is all the things we should be doing to lessen our costs.	2	1	5	1)Disagree -think the risk of scaring off the Business Managers outweighs the obvious gains of stressing the business aspects/gains of the technical architecture concept. 2) Low to no priority; Range Commander's can more readily accept a recommended "Test and Training" Process" model than a recommended "Business" model! They feel the "Business" aspects of use of their resources is under their charter! 3) Concur. 4) Good point if refine definitions.
8	Determine lead range.	1	0	10	1) why?
17	Change "Closeout" to "Report Test/Training Results"	1	3	7	
33	The LR Management & Working schedule need more definition.	1	8	3	

Table 6. LRBPM/Applications Concept Prioritized Issues and Recommendations (concluded)

45	Some puzzlement over TENA Application Concept.	1	3	7	
53	More on $ and "business" aspects. Example - on our mission funded side, our planners do not necessarily plan the most efficient exercise as there is no true cost accounting - if we are not billing the customer per operation, there has been no need for it. On the customer side, they will ask for everything every time because they are not paying for it on an individual basis.	1	2	3	1) Agree - This may be the best way to work the business aspects into TENA & it's presentation to multiple ranges/services. Everyone is concerned with accurately billing their customer/user, but few business managers want much visibility into their local billing practices - stress the independence of local billing policy, but include common overall structure/process & interfaces.
23	Look at TRACS ConOps model as example..	0	8	4	
42	Use a case description of LRBPM; maybe an alternative IDEF	0	2	9	
52	Ed mentioned RCCUDS/TEMPS as happening all before we get to this point but I don/ think the document explains that.	0	1	5	

2.5.2.2 LRBPM IDEF0 Recommended Changes

The following IDEF0 diagrams reflect the modifications recommended by the CTTRA VII LRBPM/Apps Concept Assessment Group. Text modifications are shown in italics and input/output line modifications by dashed lines.

Level A0: Conduct a Logical Range Test/Training Exercise: As illustrated in Figure 15, the assessment group recommended that:

- "Test LR Plan" box should be added to the Level A0. This activity should have two possible outputs: "Updates to the LR Plan" will reflect any changes required as a result of the test while the "Tested LR Plan" will contain the final LR Plan version that has been tested to ensure its viability for execution.
- A "Facility/Range Requirements" input to the first three activities of the model.

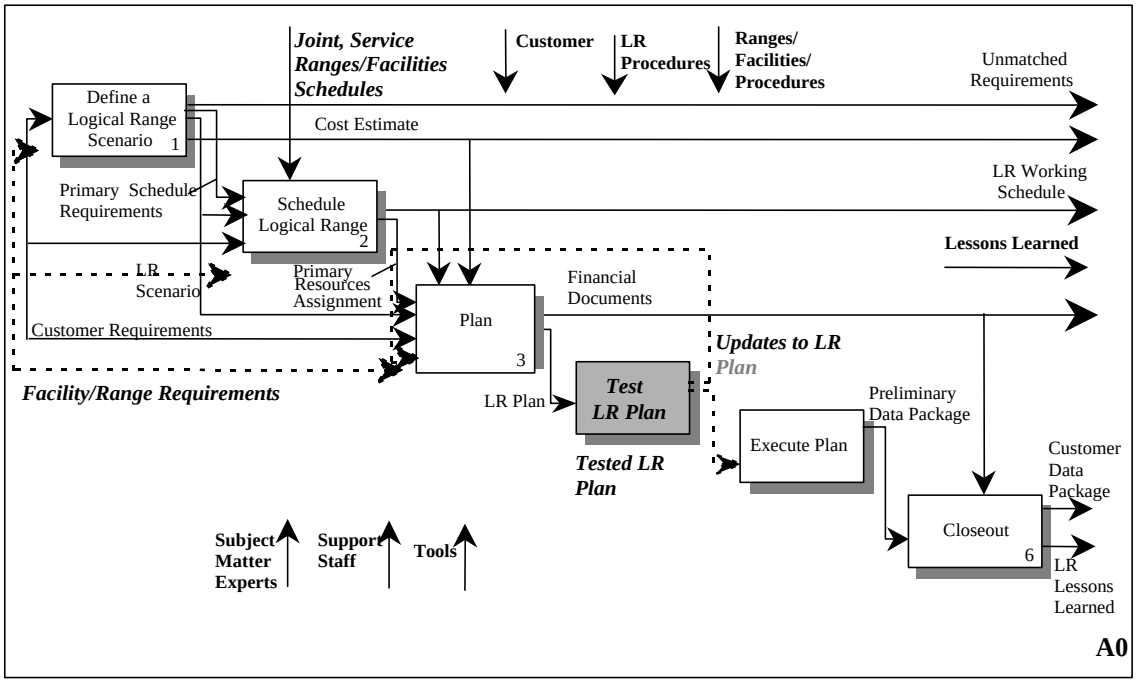

Figure 15. Level A0: Conduct a Logical Range Test/Training Exercise

Level A1: Define Logical Range Scenario: As illustrated in Figure 16, the Assessment group recommended that:

- An "Identify Information Requirements" box should be added to the Level A1. This activity has the "Information Requirements" as an output. It will define the data products required by the test/training exercise as well as any requirements from the Logical Range.
- Adding a "Facility/Range Requirements" input to the Level 1 of the model.
- Additional detail is required for this activity as well as more thorough definitions.

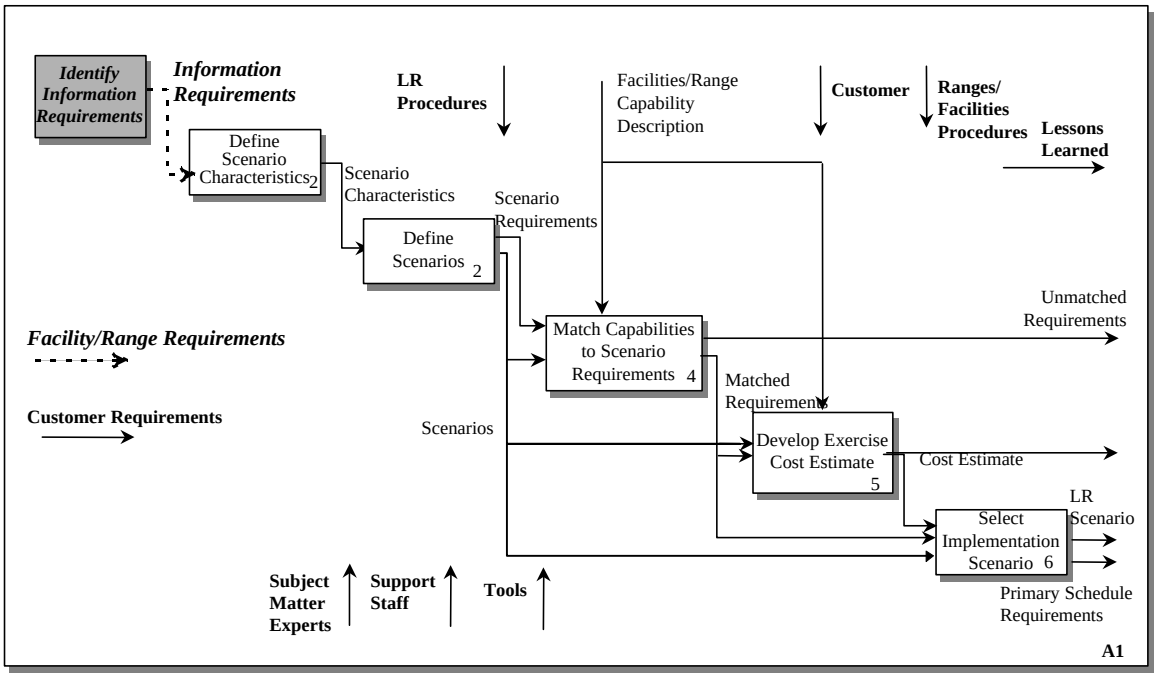

Figure 16. Level A1: Define Logical Range Scenario

Level A2: Schedule Logical Range: No changes were suggested for this activity's diagram although the group felt that additional levels of detail should be defined.

Level A3: Plan: As illustrated in Figure 17, the Assessment group suggested that:

- An output of the "Coordinate Secondary & Support Requirements" called "Unmatched Secondary & Support Requirements" will be added. This output will then become an input to the previous activity "Define Secondary & Support Requirements." In the event that either support or secondary requirements cannot be matched, the "Unmatched Secondary & Support Requirements" will become an input to the Level A1 activity, "Define Logical Range Scenario" and/or Level A2 activity, "Schedule Logical Range."
- Additional detail is required for both the Define and Coordinate Secondary & Support activities as well as more thorough definitions, in particular for secondary and support requirements.

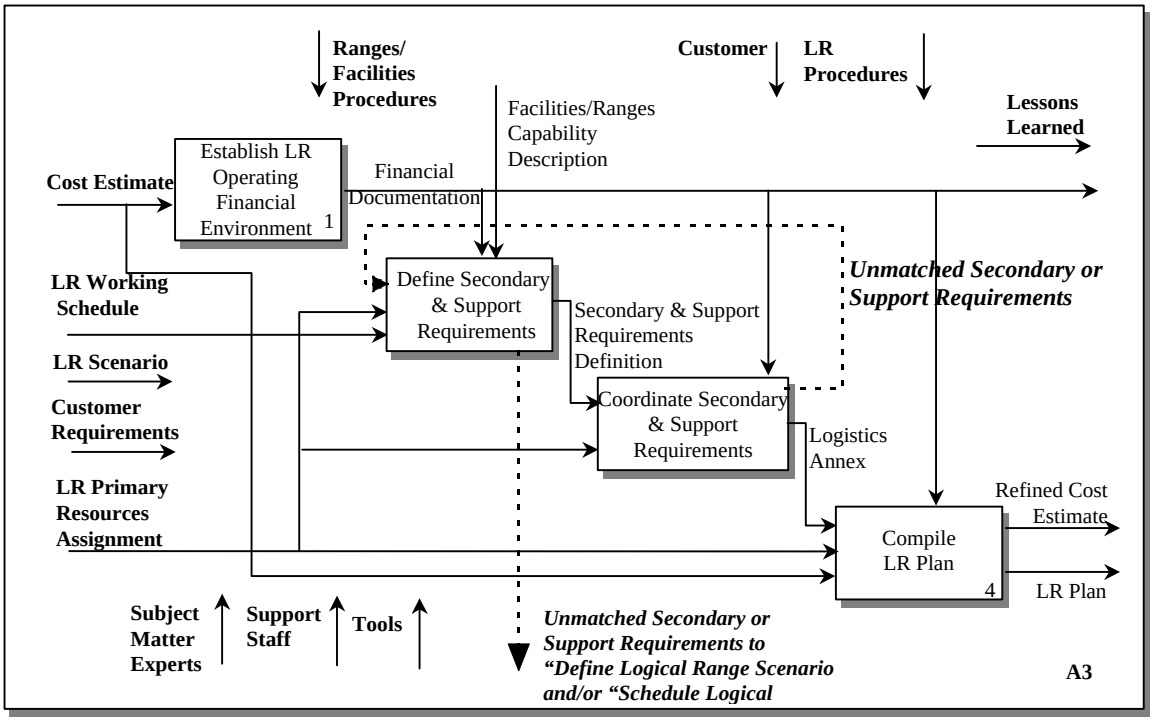

Figure 17. Level A3: Plan

Level 4: Test LR Plan: The assessment group recommended activities for the new A4 Level, "Test LR Plan" as illustrated in Figure 18. These activities need to be defined with their corresponding inputs, outputs, controls and mechanisms. Feedback loops need to be represented to allow to return to the Level 3, "Plan" phase in the event that any of the tests fail.

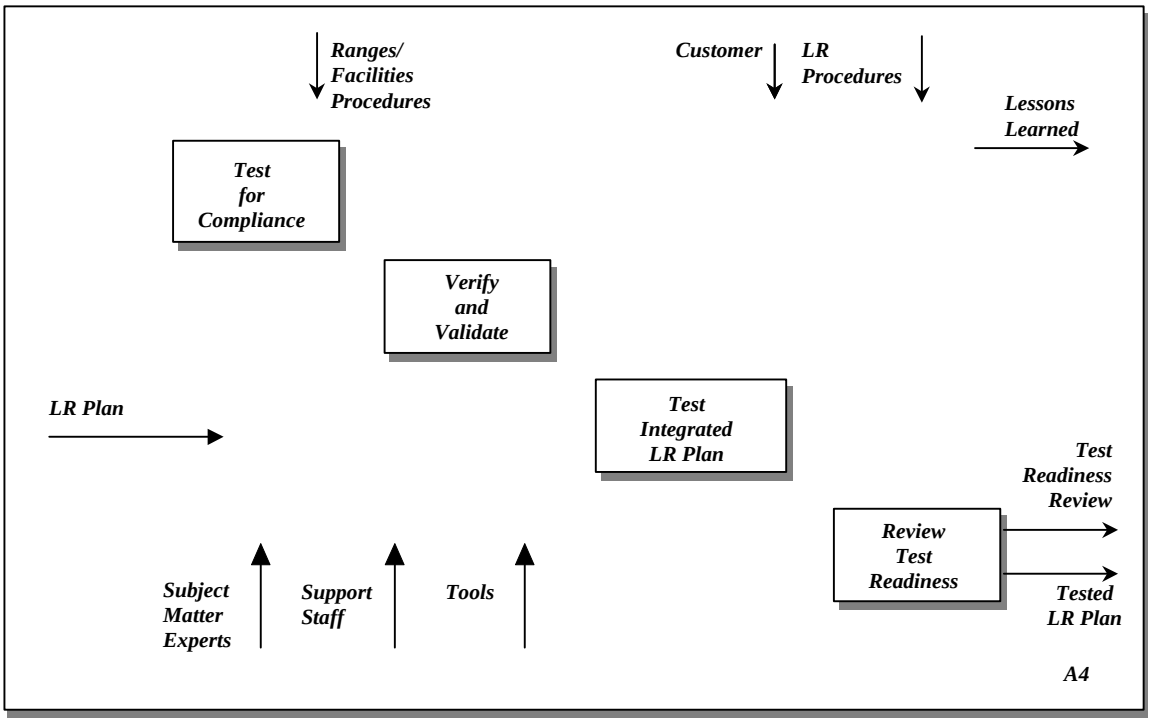

Figure 18. Level A4: Test LR Plan

Level 5: Execute Plan: As illustrated in Figure 19, the working group recommended that:

- The input of "LR Plan" is changed to "Tested LR Plan" to reflect the changes to the previous diagrams.
- Additional levels of detail should be defined in particular for the "Setup" and "Execute" blocks. Time did not permit the group to develop specific recommendations on additional levels of detail.

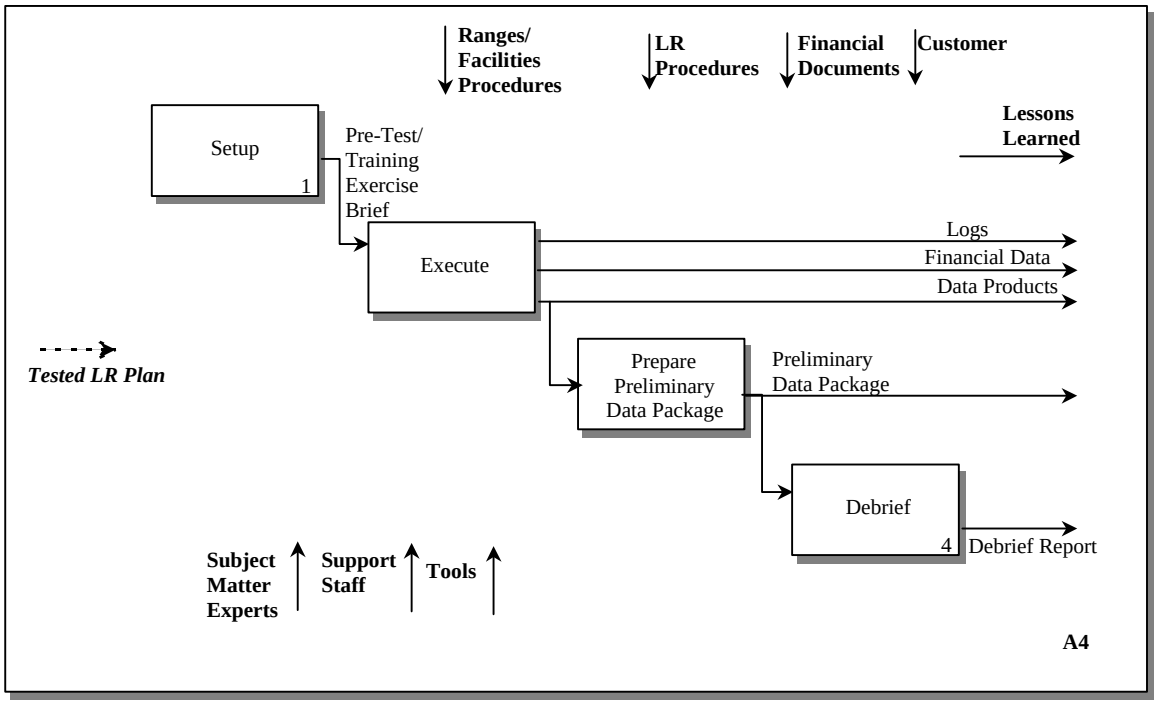

Figure 19. Level A5: Execute Plan

Level 6: Closeout: As illustrated in Figure 20, the working group recommended that:

- The "Identify Logistics/ Support & Payment Issues" activity replace "Identify Payment Issues." It's output will be "Logistics Support & Payment Issues." The input of "Customer Feedback" was also added to this activity. These additions provide for other than payment and data issues to be identified.
- The "Resolve/Close Payment/Data Issues" is replaced by "Resolve/Close Logistics/Support, Payment & Data Issues"
- Additional levels of detail should be defined.

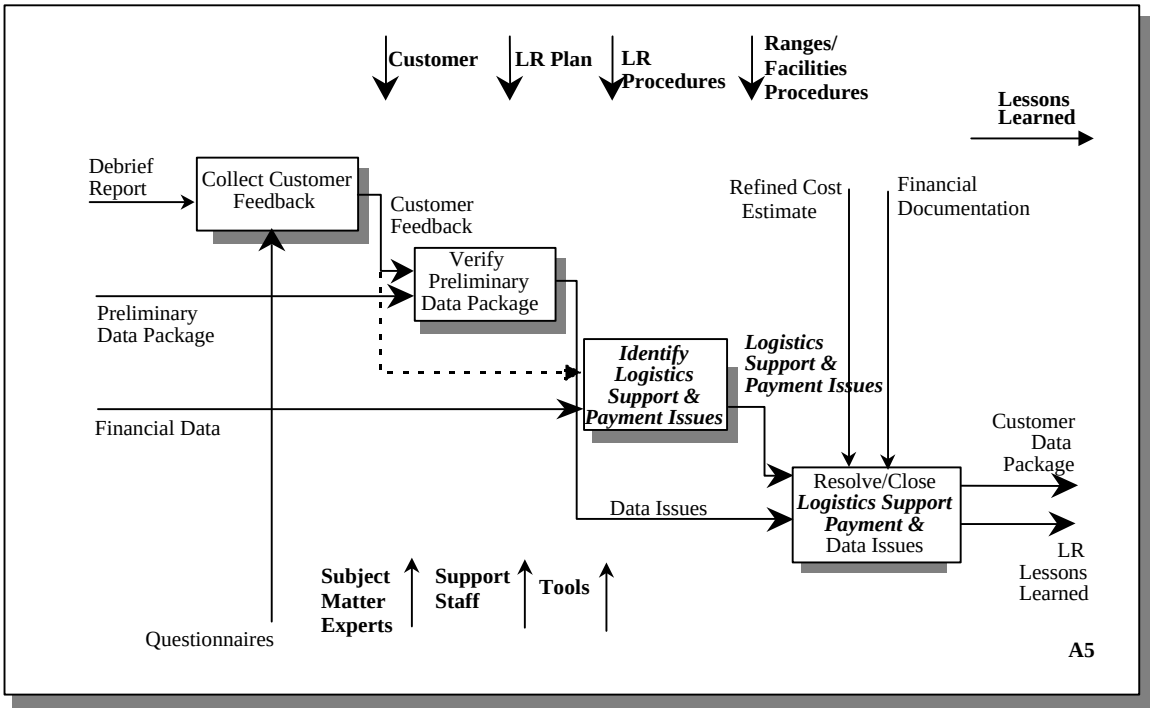

Figure 20. Level A6: Closeout

2.5.2.3 LRBPM Implementation Issues and Recommendations Review

The following Implementation Issues are excerpted from Volume V. Changes recommended by the Assessment group are reflected by strikethroughs and italics.

"As distributed exercises or tests are integrated with traditional autonomous range tests there are a variety of ~~business~~ process related issues that need to be addressed. These include:

1. Resolution of scheduling, and planning conflicts at all levels (customer, range, Fleet, joint).
2. Integration of logical range scheduling process with current scheduling process. Parallel operation of traditional range with logical range.

3. Contingency planning with respect to live participants (changes in weather, security, safety, schedule, priority, etc.). What feedback loops accommodate this?
4. Test/Training community ~~objective misalignment, and conflicts~~ *differences* (acquisition test, operational test, small team training, theater level training, etc.).
5. Selection of assets to be made interoperable (and funding to do it).
6. Execution of simultaneous overlapping logical ranges.
7. Assignment (and execution) of responsibilities (security, safety, test director, asset controller etc.) for logical range operation.
8. Merging of multiple cultures, and communities (terminology, process order, chain of command, Service perspective, warfare specialty, etc.).
9. Exercise VV&A. Are multiple objectives being accomplished, and how well?
10. Recognition that perfecting the "logical range" process is an iterative learning process.
11. Utilizing foreign assets and servicing foreign customers.
12. Situational awareness of all exercise participants and assets
13. *How to implement a LRBP without centralized planning and execution (new)*
14. *Safety implications of Real and Virtual players. (new)*"

The Assessment Group reviewed the recommendations presented in Volume V. The original recommendations and Assessment Group comments (indicated in parentheses and italics) were:

- "Promulgate the Logical Range Business Process Model for community review and discussion, *(the participants in CTTRA workshops are a fair representation of the test and training community, however, the test/exercise planning and range management community should also be involved in the review of the model)*
- Validate the LRBPM by following the process in a real environment,
  - Compare to current facilities/ranges business processes, and determine levels of compliance to legacy systems, *(yes)*
  - Conduct paper walk -through (*intra vs inter),* and
  - Define and document specific support tool requirements for the Logical Range. This should be coordinated with other related programs. *(yes)*
- Determine if lower level of detail is needed for process viability *(yes)*, and
- Create a Logical Range Business Process user guide *(yes*)."

2.5.2.4 Report out to the Plenary Body

Mr. Jack Benzie briefed the results of the group's activities to the plenary body. The briefing included the two seed questions slides shown in Figures 12 and 13 in Section 2.5.1 and the prioritized list of issues and recommendations shown in Table 6 in Section 2.5.2.2. Also included in the briefing were the five major issues taken from Table 6. The slides on these issues and recommendations are shown in Figures 21 through 26.

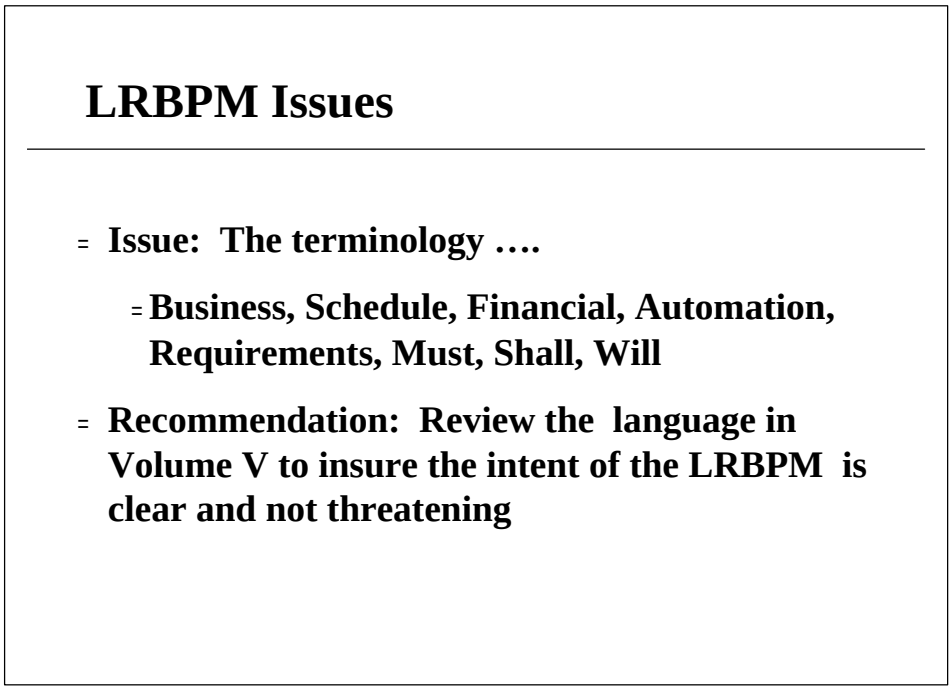

Figure 21. LRBPM/Apps Concept Outbrief - Issue and Recommendation #1

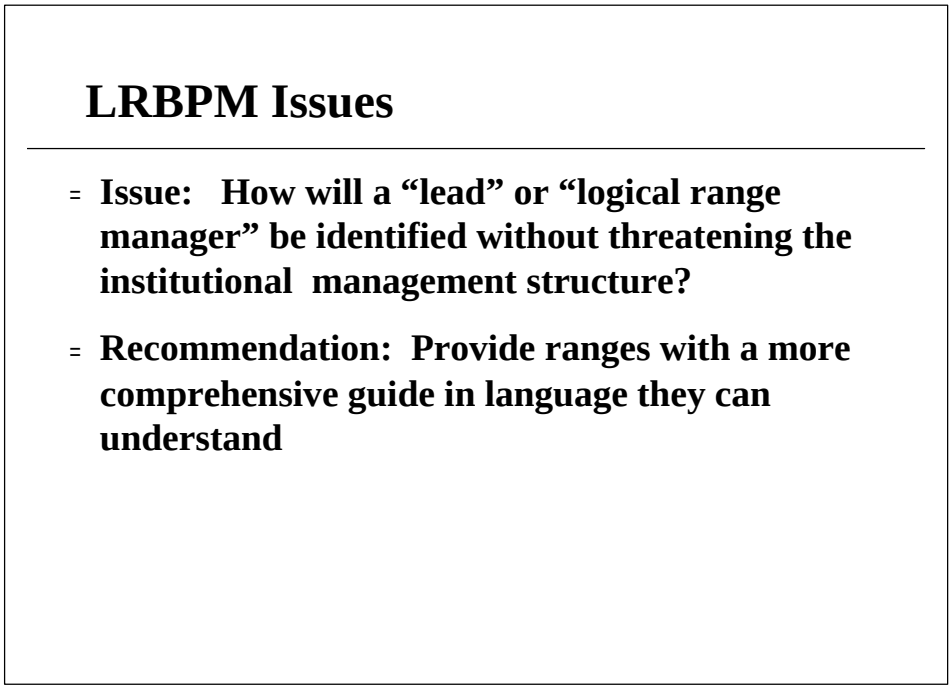

Figure 22. LRBPM/Apps Concept Outbrief - Issue and Recommendation #2

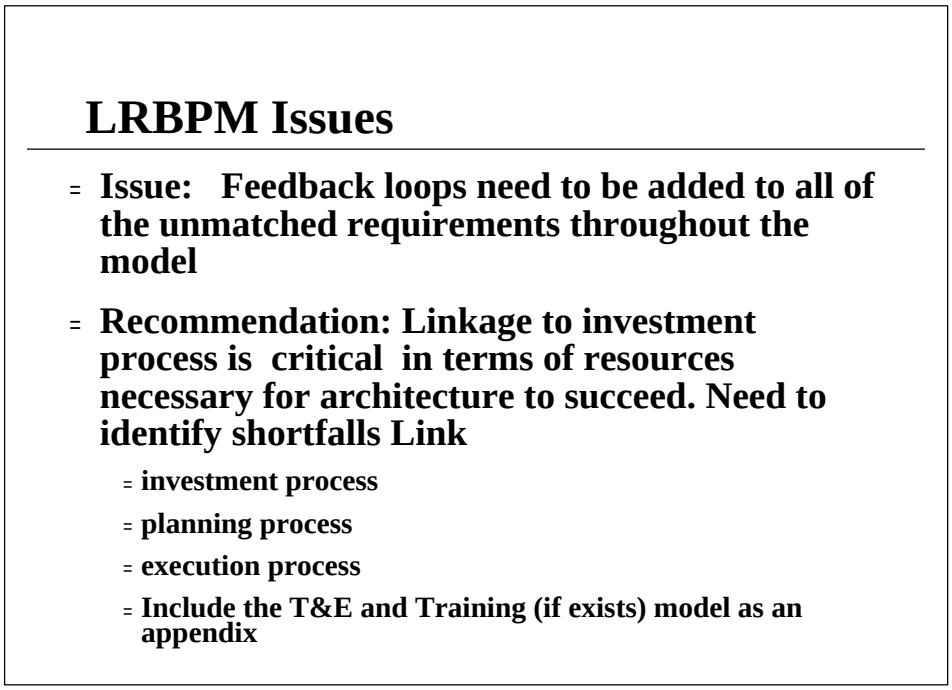

Figure 23. LRBPM/Apps Concept Outbrief - Issue and Recommendation #3

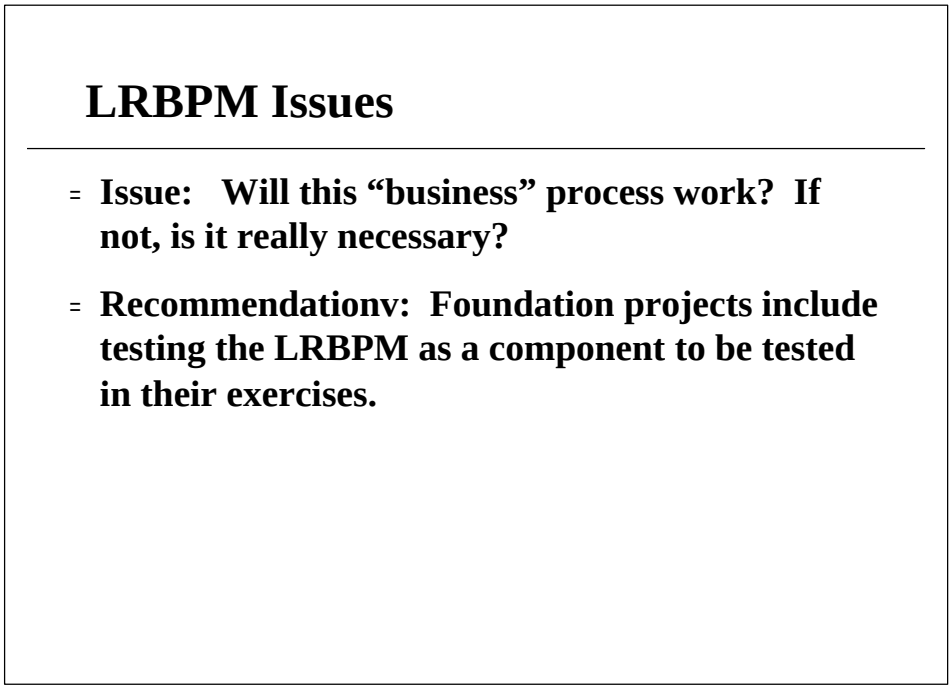

Figure 24. LRBPM/Apps Concept Outbrief - Issue and Recommendation #4

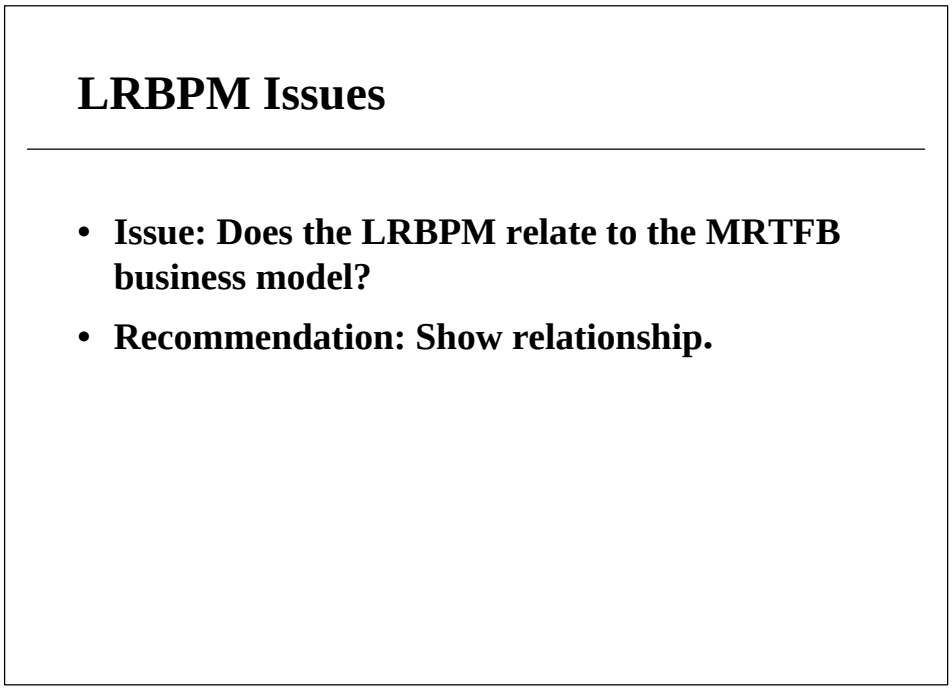

Figure 25. LRBPM/Apps Concept Outbrief - Issue and Recommendation #5

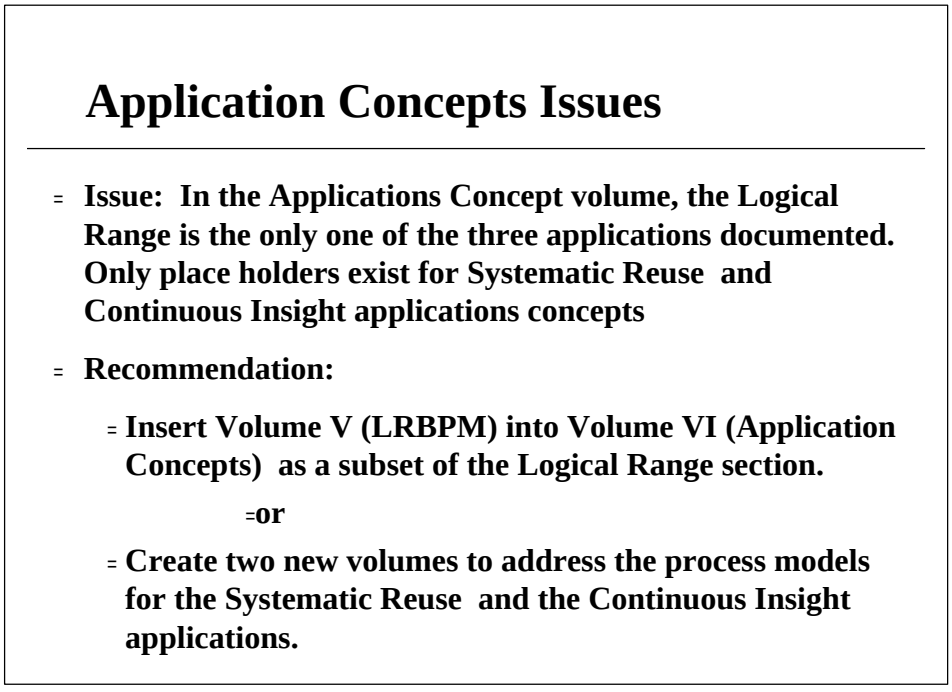

Figure 26. LRBPM/Apps Concept Outbrief - Issue and Recommendation #6

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Appendix A

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Appendix B

Agenda

Day One

0800 - 0830 Registration
0830 - 0840 Welcome/administration comments
0840 - 0910 Workshop goals, approach, and process

In-depth assessment of the Test and Training Enabling Architecture (TENA):– In the CTTRA VII workshop TENA will present an overview of the TENA products. Following guidance, ~~Technical~~ Architecture Assessment Groups will convene to assess key elements of TENA and develop recommendations for presentation to the plenary body.

0910 - 1010 TENA products briefing
1010 - 1025 Break
1025 - 1200 TENA products briefings continued
1200 - 1300 Lunch
1300 - 1400 -TENA products briefings concluded
1400 - 1645 Architecture Assessment Groups convene:

Group 1: The TENA Baseline Object Model which provides a conceptual view of the components (classes) of the TENA architecture. Some familiarity with object-oriented analysis techniques is desirable.

Group 2: The TENA Core which consists of the invariant system infrastructure services and mandatory system applications required for TENA. Detailed technical understanding of range infrastructure is desirable.

Group 3: The core set of requirements which drive the TENA architecture.

Group 4: The Logical Range Business Process Model (LRBPM) and TENA Applications Concept which defines how to conduct a test or training exercise in the Logical Range environment.

1645 - 1700 Day 1 wrap up
1700 Adjourn for the day
1800 No-host social

Day Two:

0800 - 1120 Architecture ~~Technical~~ Assessment Groups reconvene
1120 - 1200 Architecture Assessment Groups report out progress, next steps

1200 - 1300 Lunch
1300 - 1700 Architecture ~~Technical~~ Assessment Groups reconvene
1700 Adjourn for the day. Assessment groups continue at their discretion

Day Three

0800 - 0900 ~~Technical~~ Architecture Assessment Groups reconvene, complete final reports
0900 - 1000 ~~Technical~~ Architecture Assessment Groups report out~~Technic~~
1000 - 1015 Break
1015 - 1045 Briefing on the CTEIP Foundation Initiative
1045 - 1115 OSD Joint Test and Training Range Roadmap update briefing
1115 - 1200 Workshop wrap-up:
-Summary (Q&A)
Roadmap for Continuing CTTRA
Select date and place for next workshop
1200 Adjourn
1200 - 1300 Lunch
1300 - 1600 Maritime Battle Center tour

Appendix C

TENA Baseline Report and SME Briefings (Published Separately)

The TENA Baseline Report and SME Briefings are available for downloading in PowerPoint Version 7.0 format at http://www.acq.osd.mil/te/programs/cttra/

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Appendix D

OSD CTEIP Foundation Initiative Briefing (Published Separately)

The CTEIP Foundation Initiative Briefing is available for downloading in PowerPoint Version 7.0 format at http://www.acq.osd.mil/te/programs/cttra/

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Appendix E

Joint Test and Training Range Roadmap Briefing (Published Separately)

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Glossary

AEDC	Arnold Engineering Development Center
AFDTC	Air Force Development Test Center
AFFTC	Air Force Flight Test Center
AFOTEC	Air Force Test Operational Test Command
AMG	Architecture Management Group
APG	Aberdeen Proving Ground
CDAPS	Common Data Acquisition and Processing System
CTEIP	Central Test and Evaluation Improvement Program
CTTRA	Common Test and Training Range Architecture
DARPA	Defense Advanced Research Project Agency
DISA	Defense Information Systems Agency
DMSO	Defense Modeling and Simulation Office
DOD	Department of Defense
DTC	Development Test Cell
GPS	Global Positioning System
HLA	High Level Architecture
HW	Hardware
ISTF	Installed Systems Test Facility
IV&V	Integrated Verification and Validation
JADS	Joint Advanced Distribute Simulation
JPO-T&E	Joint Program Office - Test and Evaluation
JRRC	Joint Regional Range Complex
JT&E	Joint Test and Evaluation (JT&E)
JTAD	Joint Test Assets Database
JWFC	Joint Warfare Center
M&S	Modeling and Simulation
MCAS	Marine Corps Air Station
MCAVTB	Marine Corps Aviation Test Branch
MF	Measurement Facility
MIR	Multiple Integrated Ranges
MRTFB	Major Range and Test Facilities Base
NAS	Naval Air Station
NAWC-AD	Naval Air Warfare Center-Aircraft Division
NAWC-WD	Naval Air Warfare Center-Weapons Division
NRaD	Naval Research and Development
NUWC	Naval Undersea Weapons Center
NWAD	Naval Warfare Analysis Division
OM	Object Model
OPTEC	Operational Test and Evaluation Command (Army)
OPTEVFOR	Operational Test and Evaluation Force (Navy)
OSD	Office of the Secretary of Defense
PM	Program Manager
PMRF	Pacific Missile Range Facility
PRIMES	Pre-Flight Integrated Munitions and Electronics Systems
RCC	Range Commanders Council

RTI	Run Time Infrastructure
SAAM	Software Architecture Assessment Method
SETI	Synthetic Environment Tactical Integration
SME	Subject Matter Expert
STRICOM	Simulation, Training, Instrumentation Command
T&E	Test and Evaluation
TECNET	Test and Evaluation Community Network
TECOM	Test and Evaluation Command
TENA	Test and Training Enabling architecture
TIS	Test investment Strategy
TM	Telemetry
TP	Training Participant
TRA	Technical Reference Architecture
TRMP	Test Resource Master Plan
TSPI	Time, Space, Position Information
TW	Test Wing
USAEPG	U. S. Army Electronic Proving Grounds
USATC	US Army Training Support Center
VTTR	Virtual Test and Training Range
WSMR	White Sands Missile Range
YPG	Yuma Proving Ground